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Child Behavior, Animal Behavior, and Problems of Aging

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CHANGES IN INTELLECT WITH AGE: IV. CHANGES IN ACHIEVEMENT AND SURVIVAL IN OLDER PEOPLE*

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A. INTRODUCTION

Two longitudinal studies of Wechsler-Bellevue achievement in older persons have reported a relationship between survival and relative stability of scores (3, 4, 5). To account partially for greater declines in achievement for nonsurvivors, Kleemeier has postulated an imminence-of-death factor that operates to affect achievement selectively and adversely as death approaches. Such a factor might explain discrepancies in results between longitudinal and stratified studies on the effect of chronological age on achievement in older people. Also it would have important diagnostic significance for clinicians.

The studies cited in the preceding paragraph were based on small samples reflecting selected demographic characteristics. The present report attempts to cross-validate the reported results on another sample with different demographic characteristics.

B. SUBJECTS AND METHOD

All the residents of a Veterans Administration Domiciliary who had taken a complete Wechsler-Bellevue test five or more years previously were retested. The sample of 184 elderly males had a mean chronological age of 56 years at the first examination and 65 years at the second. They represented a random distribution of the *IQ* spectrum. Other demographic characteristics and the methods of testing have been described elsewhere (1).

48 months after the second examination a follow-up survey on survival status was conducted. The 141 survivors (Group I) were subdivided into three subgroups based on *IQ* at the first examination. Survivors whose first-test *IQ* was 110 or more were subgroup IA; those whose first-test *IQ* ranged from 90 to 109 were subgroup IB; and those whose first-test *IQ* was below 90 were subgroup IC.

The 43 nonsurvivors (Group II) had died from three to 42 months after

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the second examination. According to first-test *IQ*s, 33.53 per cent of Group II were superior (*IQ* 110 and above), 32.92 per cent were average (*IQ* 90 to 109), and 33.55 per cent were below average (*IQ* below 90). Group II members were subdivided into four subgroups, based on length of survival. Subgroup IIA consisted of subjects who died within 10 months of the second examination; subgroup IIB consisted of subjects who died from 11 to 20 months after the second examination; subgroup IIC consisted of subjects who died from 21 to 30 months after the second examination; and subgroup IID consisted of subjects who died from 31 to 42 months after the second examination. The cause of death for each nonsurvivor was established. 41 were autopsied.

For both groups and for each subgroup, longitudinal test-score changes were computed for subtest raw scores, scaled scores, and *IQ* scores. For each group and for each subgroup, the change in mean score, and mean unit changes per year were calculated, and chi-square values were computed. For the deceased, Kendall rank-correlation coefficients (tau) were obtained to show the relation between scores on the two tests, between time to death and scores on the second test, and between age at death and scores on the second test. Test-score changes for subjects who died from an acute illness were compared with those for subjects who had suffered a chronic illness that led to death.

C. RESULTS

At the time of the second examination, the survivors averaged 3.49 years younger than the nonsurvivors. The mean ages and the mean changes in test score of the two groups and their subgroups are given in Table 1. Following Kleemeier (5), Table 2 shows the mean annual rate of drop in score survivors and nonsurvivors. In general, the annual unit decrements show the same relative pattern as do the mean changes reported in Table 1.

On each subtest and on each of the three weighted scale scores, the subjects who died within 10 months after the second examination (Group IIA) show a greater mean decline and annual unit decrement between testings than do *all* survivors (Group I). For the subgroup that survived the second test from by 11 to 20 months (Group IIB), the sizes of the mean differences in decline and annual unit decrement tend to be smaller than those for Group IIA. Several of the differences are less than those for Group I or subgroups of Group I. For the subgroups that survived the second test more than 20 months (Groups IIC and IID), the mean test-score decline between testings and the

TABLE 1
MEAN DIFFERENCES BETWEEN THE FIRST AND THE SECOND TEST[a]

	Survivors				Nonsurvivors					
	I	IA	IB	IC	II	IIA	IIB	IIC	IID	IIB-D
Full-Scale *IQ*	3.12*	4.13*	3.68*	.88	3.00	6.57*	2.91*	2.30	1.79	2.31*
Full-Scale Score	9.43*	11.46*	9.94*	9.06*	10.63*	17.43*	11.67*	8.40*	7.93*	9.30*
Verbal Score	4.56*	6.16*	4.36*	3.12*	4.21*	9.43*	4.67*	2.30	2.57	3.19*
Performance Score	4.87*	5.30*	5.57*	2.95*	6.42*	8.00*	7.00*	6.10*	5.36*	6.11*
Comprehension	.89*	1.49*	.84*	.29	.28	1.86	1.09	.20	+ 1.15	+ .03
Digit Span	.59*	1.13*	.54*	.03	.58	1.00	.33	.40	.72	.50
Arithmetic	.81*	.80*	.96*	.55*	.30	1.00	.33	+ .40	.43	.17
Similarities	1.25*	1.82*	1.15*	.83*	2.31*	3.86*	2.25*	.90	2.57	2.00*
Picture Arrangement	.69*	.33	.97*	.56	1.68*	1.29	2.50*	1.10	1.57*	1.75*
Picture Completion	.44*	.18	.62*	.38	.74*	1.00	.42	1.00	.72	.69*
Block Design	2.99*	3.77*	3.19*	1.70*	4.09*	5.85*	2.67*	3.70*	4.71*	3.75*
Object Assembly	1.80*	2.18*	1.78*	1.41*	2.72*	3.43*	2.83*	1.50	3.14*	2.58*
Digit Symbol	3.93*	5.89*	4.29*	.70	5.29*	7.93*	5.38*	3.55*	5.14*	4.78*
Information	.89*	.80*	.92*	.94	1.33*	3.00*	1.08	1.70*	.43	1.00*
Vocabulary	2.70*	3.04*	2.61*	2.49*	3.04*	6.21*	3.14*	.90	2.82*	2.42*
Age	64.16	64.33	64.66	62.79	67.65	68.00	65.83	69.20	67.93	67.58

[a] Except for those marked plus (+), all differences are minus (—).
* $p < .05$.

TABLE 2
ANNUAL UNIT RATE OF CHANGE[a]

Variable		Survivors					Nonsurvivors			
	I	IA	IB	IC	II	IIA	IIB	IIC	IID	IIB-D
Full Scale Score	1.04	1.25	1.04	.76	1.17	2.01	1.26	.97	.84	1.01
Verbal Score	.52	.72	.45	.40	.46	1.13	.51	.24	.27	.34
Performance Score	.52	.53	.59	.36	.71	.88	.75	.73	.57	.67
Comprehension	.09	.17	.08	.02	.04	.23	.14	.00	+ .12	.00
Digit Span	.06	.14	.05	.00	.06	.13	.02	.04	.08	.05
Arithmetic	.09	.10	.10	.08	.04	.10	.03	+ .05	.07	.02
Similarities	.14	.17	.12	.13	.29	.53	.28	.11	.30	.24
Picture Arrangement	.08	.01	.11	.10	.19	.18	.26	.02	.14	.19
Picture Completion	.05	.03	.06	.05	.08	.06	.05	.11	.08	.08
Block Design	.32	.43	.34	.18	.44	.66	.30	.37	.49	.39
Object Assembly	.18	.24	.16	.16	.32	.36	.32	.19	.38	.31
Digit Symbol	.46	.73	.50	.04	.60	1.09	.45	.42	.61	.51
Information	.09	.08	.09	.07	.15	.34	.12	.02	.05	.12
Vocabulary	.33	.34	.31	.32	.36	.68	.37	.11	.38	.30

[a] Except for those marked plus (+), all rates indicate declines.

annual unit decrements present a mixed picture. Some changes are greater than those for Group I or subgroups of Group I. Some are less.

Both Group I and Group II had lower mean scores on the second test. On the first test the (potential) nonsurvivors had approximately the same mean raw scores as did the survivors. On the retest the mean raw scores and the mean scaled scores for those who would survive are not significantly different from the mean scores of those who would die in the next 42 months. For the comprehension, the arithmetic, and the combined-verbal scaled scores the decreases are greater for the survivors than for the nonsurvivors. For the digit-span subtest, the mean decrease is the same for both groups. For the other variables, nonsurvivors show greater mean decreases than survivors between examinations. For no variable is a difference for Group II significantly different from the corresponding difference for Group I. See Table 3.

TABLE 3

SIGNIFICANCE OF DIFFERENCES BETWEEN SURVIVORS AND NONSURVIVORS[a]

Variable	I II	I-A II	I-A II-A	I-A IIB-D	I-C II	I-C II-A	I-C IIB-D
Full Scale Score	N	N*	N	N*	S	N	S
Verbal Score	N*	N*	N	S*	N	N	N
Performance Score	N	N	N	N	S	S	S
Comprehension	N*	S*	N	S*	N	N	N
Digit Span	N	N*	N*	N*	N	N	N
Arithmetic	N*	N*	N	N*	N*	N	N*
Similarities	N	N	N	N	S	S	N
Picture Arrangement	N	S	N	S	N	N	N
Picture Completion	N	N	N	N	N	N	N
Block Design	N	N	N	N	S	S	S
Object Assembly	N	N	N	N	N	N	N
Digit Symbol	N	N*	N	N*	S	S	S
Information	N	N	S	N	N	N	N
Vocabulary	N	N	N	N*	N	N	N

[a] N = difference not significant; S = difference statistically significant.

* Indicates that survivors show the larger decline in achievement.

When nonsurvivors are compared with subgroups of the survivors grouped by *IQ*, significant differences are found. The lowest-*IQ* survivors (Group IC) exhibit significantly smaller decrements in full-scale scores and performance scores than do nonsurvivors. Some of the subtests (similarities, block-design, and digit-symbol) also show significant differences. The highest-*IQ* survivors (Group IA) show significantly greater decrements in verbal score than do the nonsurvivors who survived the second test more than 10 months. Only on arithmetic, do low-*IQ* survivors show a greater decline than do nonsurvivors. High-*IQ* survivors show larger declines than do nonsurvivors on a wider range of weighted scores and subtests (see Table 3).

With one exception, the chi-square values for the differences in frequencies of decline between survivors and nonsurvivors do not reach significance. The exception is for the intergroup differences between all survivors (Group I) and all nonsurvivors (Group II) on picture-completion scores. For the full-scale *IQ* and the verbal scores and for the comprehension, arithmetic, picture-arrangement, and vocabulary subtests, the frequencies of decline are greater for survivors than for nonsurvivors.

With one exception, the chi-square values for the differences in frequencies of decline between any subgroup of survivors and all nonsurvivors (or any subgroup) are below the level of significance. The exception is for the digit-span subtest between low-*IQ* survivors and nonsurvivors who died within 10 months of the second examination. A large proportion of the chi-square values are close to zero. High-*IQ* survivors show many frequencies of decline as great as or greater than do all nonsurvivors or any subgroup of nonsurvivors. Even low-*IQ* survivors show greater frequencies of decline than do some subgroups of the nonsurvivors.

Jarvik and Falek (3) report a significant chi square when vocabulary and critical percentage changes in the similarities test and the digit-symbol test are combined into doublets or into a tricluster. In the present study, the frequency of test-score decline on any two or all three of the foregoing subtests for all survivors was compared with the corresponding frequency for all survivors and for each subgroup of survivors, but all the chi squares are below an acceptable level of significance. When high-*IQ* survivors and low-*IQ* survivors are compared with all survivors or with any subgroup of survivors, the results are similar.

Kendall rank-correlation coefficients are given in Table 4. As can be seen, for all nonsurvivors correlations between the time to death and full-scale, verbal, and performance scores on the second test approximate zero.

Table 4 also shows the correlations between the time to death and change in score between examinations. For all nonsurvivors there are small but significant positive correlations for the full-scale and the verbal scores as well as for the comprehension and information scores. In general, all correlations tend to be positive.

For the nonsurvivors who died within 10 months of the second examination, there are no significant correlations for the scaled scores, but the correlations for comprehension and object assembly are significant. These correlations and those for the scaled scores are negative. For the nonsurvivors who survived the second examination more than 10 months, the correlations tend to fall around zero.

Nonsurvivors who died from an acute physical insult or illness show a greater annual rate of drop in score than do nonsurvivors who died after a long chronic illness. See Table 5. Nonsurvivors who died from pneumonia show the largest annual rate drop between tests. Even when nonsurvivors who died from pneumonia are combined with the nonsurvivors who died after a chronic illness, the mean annual rate of drop in score is less than for the nonsurvivors who died after a short acute illness. An analysis of variance indicates that the rate of drop is not significantly different for the various cause-of-death categories.

TABLE 4
KENDALL RANK-ORDER CORRELATIONS[a]

Variable	II QY	II QZ	II QY.Z	II XY	II XY.Z	IIA XY	IIB-D XY
Full Scale Score	+.04	−.22	+.04	+.22*	+.23	−.36	+.02
Verbal Score	+.01	−.12	+.01	+.24*	+.24	−.11	+.04
Performance Score	+.02	−.26	+.02	+.11	+.11	−.42	+.03
Comprehension	+.17	−.14	+.17	+.27*	+.27	−.74*	−.06
Digit Span	−.06	−.08	−.06	+.10	+.10	+.06	+.01
Arithmetic	−.07	−.16	−.07	+.05	+.05	−.32	−.01
Similarities	+.08	−.16	+.08	+.07	+.07	+.33	+.04
Picture Arrangement	−.01	−.33	−.01	+.02	+.02	−.42	−.03
Picture Completion	−.09	−.13	−.09	−.01	−.01	+.05	+.06
Block Design	.00	−.30	.00	+.02	+.02	−.46	+.06
Object Assembly	+.09	−.22	+.09	−.03	−.03	−.81*	−.01
Digit Symbol	+.13	−.35	+.15	+.03	+.02	+.57	+.07
Information	+.06	−.10	+.06	+.28*	+.28	.00	+.04
Vocabulary	+.02	−.07	+.02	+.10	+.10	−.38	+.01

[a] X = change in score between tests, Y = time from second test to death, Z = age at final test, Q = score on second test.

* $p < .05$.

TABLE 5
ANNUAL RATE OF CHANGE FOR CAUSE OF DEATH AS DETERMINED BY AUTOPSY

	Cause of death									
	Acute illness $N = 20$		Pneumonia $N = 7$		Chronic illness $N = 12$		Acute illness plus pneumonia $N = 27$		Chronic illness plus pneumonia $N = 21$	
Score	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Full-Scale Score	1.17	.72	1.32	1.87	.91	1.04	1.21	1.14	1.04	1.38
Verbal Score	.55	.59	.66	1.23	.13	.38	.58	.81	.30	.87
Performance Score	.62	.48	.66	.75	.78	.68	.63	.57	.74	.71

D. Discussion

Kleemeier (4) reported that "when intellectual decline does occur, it is likely to follow an individual pattern marked by relatively sharp decline." In the present study, such a relatively sharp decline is found principally for the nonsurvivors who died within 10 months of the second test. Although the amounts of decline or the declines per unit of time for this subgroup are not significantly larger than those for survivors, they are consistently greater. With minor exceptions, they are also consistently sharper than those for the remainder of the nonsurvivor subgroups.

Nonsurvivors who survived the second test more than 10 months show a consistently sharper decline in score than do survivors. As the interval between the second test and death increases, the amount of decline and the rate of decline decrease. For subgroups IIB and IID, the amount of decline and the rate of decline is less than that for all survivors. If there is an imminence-of-death factor that affects scores of cognitive tasks, its effects are less evident when the time-to-death interval is greater than 10 months than when it is 10 months or less.

Because our study is retrospective in nature, we cannot say how long before death an imminence-of-death factor begins to function. A duration of more than 20 months is not supported by the relatively smaller declines for the nonsurvivors who survived the second test more than 20 months (Groups IIC and IID). For the nonsurvivors who survived the second test more than 10 months (Groups IIB, IIC, and IID), the mean annual unit drop in score is less than that for all survivors for the full-scale score and the verbal score.

Other findings also challenge the concept of a long-time effect of an imminence-of-death factor. When the time to death is 42 months, nonsurvivors do not show smaller achievements or greater test-retest declines than do survivors. The correlations between the time to death and change in score are predominately negative for Group IIA. When subjects who survived up to 42 months are included, the correlations change to a predominately positive character.

The small differences that occur between the two groups can be readily explained by chance variation and the fact that the (potential) nonsurvivors averaged of 3.49 years older than the survivors at the time of the second examination. Nonsurvivors show the greater decline in those performance subtests that are most susceptible to decrement with advancing age. On verbal subtests, nonsurvivors performed as well as did survivors.

With a sharp decline in intellectual achievement, one would expect a negative correlation between time to death and the annual unit decrement. Nonsurvivors who died within 10 months of the second test should have exhibited the largest declines in achievement. Table 4 shows the foregoing expectation to be a valid one. For subjects who survived 10 months or longer, the correlations are approximately zero.

The differences between our results and those reported by Kleemeier (4) and Jarvik and Falek (3) may be due to difference in sampling procedures. Kleemeier (4) and Jarvik and Falek (3) used subjects whose mean age was more than 75 years. It is possible that the rates of change in such groups are different from those in groups 10 years younger. The imminence-of-death factor may be more potent in the very old than in those in their seventh decade of life.

The randomness of our *IQ* distribution may also be a factor. Although original endowment does not appear to be related to longevity or to the mortality rate (approximately the same per cent of subjects in each of the three *IQ* categories died), it would have affected changes in scores between examinations. The effect of original endownment has been reported by Terman and Merrill (7) for children and by Berkowitz and Green (2) for aged males.

The population of the present study exhibited a normal random *IQ* distribution on the first examination (1). On retest, the survivors with the highest *IQ* scores showed the largest changes in subtest and scaled scores; while the lowest *IQ* survivors showed the smallest changes. Also on the retest, the mean changes for the survivors with the highest *IQ* scores were more frequently significant than were the mean changes for the low-*IQ* subjects. The mean changes in full-scale score for Subgroups IIB and IID were smaller but not significantly different from those for all survivors; however the mean changes in full-scale score and performance score for the nonsurvivors in Subgroups IIB and IID were significantly larger than the corresponding changes in score for the low-*IQ* survivors (Group IC). On the verbal score the highest-*IQ* survivors (Group IA) showed a significantly larger decrease on the retest than did Subgroups IIB and IID.

As indicated earlier, approximately the same per cent of subjects in each *IQ* category died within the period under study. If the deaths had been excessive in the high-*IQ* subgroup and deficient in the lowest-*IQ* subgroup, the differences in mean change or in change per unit of time between the survivors and the nonsurvivors would have produced significantly greater declines for the nonsurvivors—even for the nonsurvivors who survived the second test more than three years.

The correlation values and the size of the chi squares for intergroup differences reported in the previous studies on the effect of impending death are *not* validated by the present study.

Kleemeier (4) reported a Kendall rank-correlation coefficient (tau) of .25 between time to death and total weighted Wechsler-Bellevue score. Our results show a correlation not significantly greater than zero. Kleemeier also reported a correlation of .34 between total weighted score and age at the time of the second test. Our results show a correlation of —.22. Because achievement scores for an unselected sample tend to be lower for older people than for younger people, the negative correlation is more consistent with our expectations.

The disparity between the intergroup frequency differences found by Jarvik and Falek (3) and those of the present study probably are due to sample selection. The number of Jarvik and Falek's subjects varied for the different subtests. In computing the chi square for the intergroup differences, Jarvik and Falek excluded the potential results of 11 subjects who had survived five or more years after the second test, 31 persons who were alive but who had not survived five years beyond the second test, and two subjects who were deceased. The present study is based on all subtests for the entire sample population.

If impending death adversely affects scores on cognitive tasks, people who died from a chronic illness should show its effects; while its effects should be absent for people who died unexpectedly. In our sample all subjects suffered some pathology, but only a relatively small number died from the culmination of chronic pathology. To establish for old people the complete absence of a chronic pathological status that is completely unrelated to the eventual cause of death is difficult. Is death from an acute fulminating pneumonia the end process of a chronic deterioration? Or is acute fulminating pneumonia an accidental cause of death? Is a death from myocardial infarction (in a person who has no previous history of cardiac disease) an unexpected death?

The authors considered as acute deaths those that resulted from acute myocardial infarcts, peritonitis, and other septicemias, complications of surgery and trauma. Except for pneumonia, all other causes of death were considered to have resulted from chronic disease. Cardiac deaths in persons who were known to have a chronic cardiac condition were listed as due to chronic illness.

The autopsy findings were the basis of the cause-of-death classifications. An imminence-of-death factor that affects the scores of those who are to die within 10 months of the second test would be expected to be associated with organic illness. All subjects in Subgroup IIA had some organic illness, but the illnesses did not differ from those of other nonsurvivors or survivors. The deaths of six of the seven members of Group IIA did not result from organic illness but from new and acute disorders. The seventh person, whose decline between tests was the most marked, died from an encephalopathy that had lasted several years. Sanderson and Inglis (6) have reported that among aged people there is a significant association between demonstrable learning impairment and death. It would be instructive to know for all previous studies how many of the deaths were of the acute or chronic type.

E. Summary and Conclusions

One hundred eighty-four aged males, who represented a random sample of the *IQ* spectrum, were given the Wechsler-Bellevue test twice. Forty-three of the subjects died within 42 months of the second examination. The test-score changes for these subjects were compared with test-score changes for 141 who were living at the time of our study. Our conclusions are as follows:

1. Subjects who died within 10 months of the second examination show the greatest amount and rate of decline between examinations. Other results reported by Kleemeier for nonsurvivors were not validated.
2. If an accelerated rate of decline is due to an imminence-of-death factor, there is no evidence that its effects last beyond 20 months.
3. The relative stability of test scores for survivors *vs.* the relative instability of test scores for nonsurvivors, as reported by Jarvik and Falek (3), was not validated. The frequency of decline in test score among nonsurvivors is not significantly different from that for survivors.
4. It is probable that the differences between the results of our study and those of previous studies reflects differences in the selection of the samples.
5. Subjects who die from a chronic illness do not show greater declines than do those who die unexpectedly.

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VERBAL LEARNING AND RESPONSE TIME IN THE AGED*[1]

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A. INTRODUCTION

A deficit in the learning ability of aged persons commonly has been accepted as a direct consequence of generalized central-nervous-system decline occurring with age. It has been suggested, however, that empirical studies of learning in the aged may demonstrate a performance decline rather than a true learning deficit. Eisdorfer, Axelrod, and Wilkie (3), have proposed that the older subject's deficit—as seen in experiments involving verbal learning—is related to inability to respond within the time intervals allotted. They demonstrated that when stimulus-exposure duration of an eight-item high-association word list was extended from four to six to eight seconds, increasing improvement was found on the part of aged *S*s in relation to younger controls. In a further study extending the exposure intervals of the stimulus words to 10, 12, and 14 seconds, a comparison of old and young *S*s showed that aged *S*s improved monotonically as the exposure duration increased from four to 10 seconds (2). This improvement in learning with lengthening stimulus exposure is associated with an increase in the absolute number of responses on the part of aged subjects. Initial study had shown that omission errors (i.e., failures to respond) varied inversely with the stimulus-exposure interval within a series of trials, and that error reduction could not be attributed to the cumulative effect of increased exposure duration of the stimulus words; therefore it was hypothesized that "the superiority of the longer intervals is not a simple function of increased stimulus exposure," but "can be accounted for on the basis of an increase in opportunity to respond" (3). It was felt that with more time available the slower response time of the aged would be

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less of a penalty in the paced-learning situation. The next logical step in this sequence is to determine the length of time that is in fact required by aged subjects to produce a response during the paced-learning study. This would test whether or not slowed response time is the basis for the difficulty underlying the poorer learning performance of the aged.

As a further step it should also be more definitely demonstrated that opportunity to respond rather than opportunity to view the stimulus is the most important factor in the improved learning of the aged with increasing stimulus-to-stimulus duration.

B. METHOD

1. *Apparatus and Procedure*

A serial rote-learning paradigm was employed, similar to that described by Eisdorfer *et al.* (3). Stimuli were the same as those used previously and were presented to the subject in the manner described for the earlier studies. Lists were composed of eight five-letter disyllabic words: PUPIL, RIVER, TODAY, JEWEL, METAL, HONEY, WOMAN, and DOZEN. Words were highly familiar (occurring at least 41 times in a million) as rated by the Thorndike-Lorge (1944) word count (6) and highly meaningful as defined by Taylor's study (5) in which all words were associated to within 2.5 seconds by at least 80 per cent of Taylor's subjects (college students). Each of the words begins with a consonant and contains alternating consonants and vowels. Eight lists were composed, with each word appearing in a different position in each list, and each list was begun with an asterisk. The lists were assigned to subjects in each group in random sequence and presented individually by means of a slide projector. Timing was controlled by three Hunter decade-interval timers. The letters measured 2.2 inches in height at six feet from the seated subject and were easily read by all subjects.

In the present situation the stimulus words were exposed for four seconds with a seven-second interstimulus interval (four on and seven off); thus there was a total of 11 seconds from the onset of a given stimulus to the onset of the succeeding one. This time sequence was used so that, while the exposure time was identical with the four-second condition of the earlier experiments, the total time from the onset of one stimulus to the succeeding one was identical with the earlier 10-second exposure condition (which had included a one-second interstimulus interval for a total of 11 seconds between stimuli). As in the previous studies, a 45-second interlist time was employed.

Subjects learned to a criterion of two consecutive errorless trials or a maximum of 15 trials were run.

The apparatus was modified to include a voice key that activated a marking pen on a Grass Model 5 Polygraph write out. A small (one by three cm) photosensitive cell placed in one corner of the projection screen was used to record the exposure time of each stimulus word on the same write out; consequently it was possible to determine the duration following exposure of the stimulus word after which the subject made his response. A technician monitoring the projection equipment and recording subjects' responses was also able to keep track of noise artifacts in the experimental situation.

2. *Subjects*

Subjects were 15 white men drawn from the North Carolina Employment Security Commission in Durham. All subjects were over 60 years of age (mean age, 71.6 years) and were screened using the vocabulary subtest of the Wechsler Adult Intelligence Scale. They represented essentially the same pool of subjects as that for the earlier experiments. To conform with the previous studies, only those subjects scoring between six and 12 on the vocabulary subscale were used.

The results were compared with those obtained previously from 66 subjects under conditions of four-, six-, eight-, 10-, 12-, and 14-second exposure (with one-second interstimulus intervals, as discussed earlier).

C. RESULTS

Table 1 shows a comparison of the age and vocabulary score of *S*s from the present study with those of the earlier conditions. Vocabulary scores were not different between subjects under any of the conditions as examined by a simple randomized analysis of variance design (4). Figure 1 gives the mean number of errors made under the four-seconds-on-and-seven-seconds-off exposure condition compared with the four-seconds-on-and-one-second-off condition through the 14-seconds-on-and-one-second-off conditions. The four-

TABLE 1
MEAN AGES AND MEAN VOCABULARY SCORES

	Exposure time (in seconds)						
Mean	4	6	8	10	12	14	4_7
Age	67.4	66.3	65.9	66.3	67.5	70.4	71.6
Vocabulary	7.9	8.2	8.9	8.3	8.3	8.8	8.7

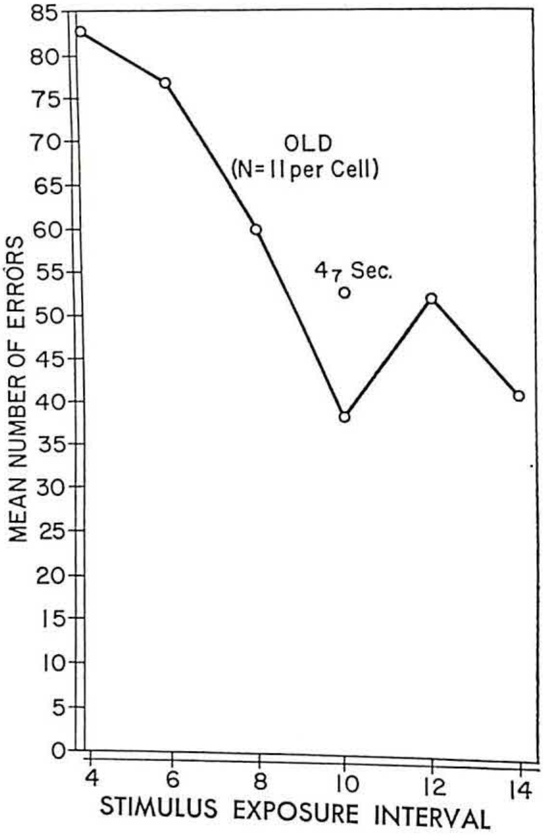

FIGURE 1
MEAN ERRORS IN LEARNING AS A FUNCTION OF EXPOSURE CONDITION

seconds-on-and-seven-seconds-off condition appears to be associated with the same level of learning as the eight-seconds-on-and-one-second-off and the 10-seconds-on-and-one-second-off exposure conditions. A simple randomized analysis-of-variance design for errors made at the various stimulus-exposure conditions yields a significant F test ($F = 5.38$ with $df = 6, 74$). Further analysis by t test, using $msw = 74$ as df, demonstrates significant differences in performance to the four-seconds-on-and-seven-seconds-off group and the four-seconds-on-and-one-second-off condition and the six-seconds-on-and-one-second-off condition ($t = 3.17$, $p = .01$; and $t = 2.54$, $p = .05$). The four-seconds-on-and-seven-seconds-off condition was not different from the eight-second, 10-second, or longer exposure conditions.

Figure 2 shows the mean number of omission and commission errors made

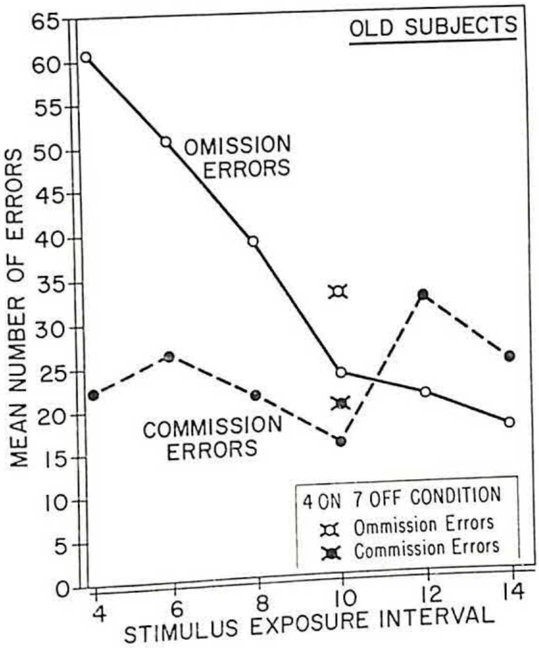

FIGURE 2

ERRORS OF OMISSION AND COMMISSION AS A FUNCTION OF EXPOSURE CONDITION

by the aged subjects under the four-seconds-on-and-seven-seconds-off condition as compared with performance under the other exposure conditions. The similarity between the four-seconds-on-and-seven-seconds-off condition and the longer exposure intervals is apparent. The total number of omission errors is significantly below that of the four-second and six-second exposure intervals ($t = 3.71$, $p = .01$; and $t = 2.40$, $p = .05$; $df = 74$) but commission errors are not different. No differences are seen between the four-seconds-on-and-seven-seconds-off condition and the 8-second and 10-second exposure conditions with regard to type of error.

Table 2 indicates the time taken by subjects to respond, following pre-

TABLE 2

RESPONSE TIME (IN SECONDS) FOR CORRECT AND INCORRECT RESPONSES

	Response			
Parameter	Correct	Incorrect	Difference	t*
Mean	3.73	5.21	1.48	4.12
SD	1.38	1.70		

* $df = 14$, $p = .01$.

sentation of the stimulus. In analyzing response time a criterion of learning for each word in its correct position was decided upon; thus subjects who placed words correctly three times in succession *or* twice in succession (if on the last two trials) were considered to have learned the word. Words beginning with the correct series were tabulated as postlearning; those responses made prior to the correct series were considered prelearning. The mean response time for prelearning conditions was 5.01 seconds; for postlearning responses, 3.39 seconds. The difference (1.62 seconds) was examined by t-test analysis and the resultant t of 4.93 was significant at $p = .01$. The results were further studied by analyzing all correct responses and all incorrect responses without regard to their position in the learning sequence. The mean response time for all incorrect responses was 5.21 seconds; for correct responses, 3.73 seconds. The difference (1.48 seconds) was examined and a t test of 4.1 obtained (with $df = 14$) significant at $p = .01$.

TABLE 3
RESPONSE TIME (IN SECONDS) FOR PRELEARNING AND POSTLEARNING CONDITIONS

	Condition			
Parameter	Prelearning	Postlearning	Difference	t*
Mean	5.01	3.39	1.62	4.93
SD	1.65	1.43		

* $df = 14$, $p = .01$.

D. Discussion

This study was performed to determine whether increasing stimulus-exposure time in a learning situation helps the aged because of additional time to view the stimulus material or whether some other factor secondary to a slower pace (e.g., more time to respond) is involved. On the basis of previous work, it was hypothesized that stimulus-viewing time was less significant; and the more important variable was believed to be the requirement of the aged for additional time to mobilize responses. The present results support the hypothesis that the slower pacing of the stimuli is a significant factor beyond merely allowing additional time to view the material to be learned. The results of the four-second-exposure-seven-second-off condition are similar to those of the eight-second and 10-second exposure conditions. The data for omission and commission errors similarly support the contention that the four-seconds-on-and-seven-seconds-off condition is most similar to the 10-second exposure with a one-second-off condition. Commission errors do not change appreciably with exposure condition, but more time to respond results in a significant reduction in errors of omission; thus with increased time between stimuli there is a greater tendency on the part of the aged subject to make a response. The pattern of errors and consequently the overall performance appears to be more a function of total elapsed time between successive stimulation and not merely the amount of time available for viewing the stimulus.

The nature of the earlier studies also leads to the hypothesis that time to respond might be a significant factor in the learning deficit of aged persons, and that increasing exposure of stimuli serves primarily to allow aged subjects the additional time to make their response. The present study undertook a more definitive examination of this question by measuring the time taken by the aged *S*s to produce responses. It is important to note that the prelearning and postlearning mean response times of aged subjects fall within the time intervals available under the more rapidly paced conditions. The prelearning mean response time of 5.01 seconds is well within the limits of the six-seconds-on-and-one-second-off condition and approximates the four-seconds-on-and-one-second-off situation. From a neurophysiologic point of view, it is also significant to note that the mean postlearning time (i.e., 3.39 seconds) is well within the limits set by both of these exposure conditions. It should be re-emphasized that there were significantly fewer errors and more responses made at the four-seconds-on-and-seven-seconds-off condition than at the four-seconds-on-and-one-second-off condition. The results of the study support the thesis that rapid stimulus pacing and its associated decrease in responsivity contribute to a deficit in verbal learning scores in aged subjects, but that this is *not a simple function of inability* to respond during the available time.

On the basis of the present results it would appear that the aged person can formulate and produce the simple response required comparatively rapidly. The deficit then may lie in some factor relating to the older persons' propensity to respond (or to withhold responses) in relation to the time programming of the material to be learned.

A possible explanation for these findings is the relative attention-getting component of the more rapidly paced stimuli. Subjects in all the conditions doubtless develop a preparatory set for the oncoming stimulus. In effect, they learn the approximate time for the oncoming stimulus and in attending to the word to be presented inhibit responses to previously exposed material. Under more slowly paced conditions such an effect would be relatively less inhibiting because proportionately more time would be available following the onset of stimulation prior to the initiation of the oncoming inhibitory potential.

An alternative and perhaps more intriguing explanation may lie with the total anxiety generated by the situation. More rapid pacing may create greater stress upon the part of the subjects. Aged subjects, who typically described heightened anxiety concerning their performance in the learning task, may be finding the situation even more stressful with more rapid pacing—or with increasing task difficulty. This increase in overall anxiety in subjects already faced with a complex task may result in withdrawal from the situation (i.e., in fewer responses) and a consequent poorer performance.

In this context, it has been suggested that older subjects may require a greater degree of confidence in their judgment before responding (1). Research strategy directed along these lines seems appropriate for further elucidation of the role of response in conditioned or situational stress as determinants of performance in relation to developmental level postmaturity.

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REINFORCEMENT SCHEDULES AND RESPONSE VARIABILITY IN FIRST-GRADE CHILDREN*[1]

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A. INTRODUCTION

We have previously reported concerning reinforcement schedules and response variability in preschool children (1). The study was concerned with the effects of prior experiences of fixed-ratio, variable-ratio, and regular reinforcement on the subsequent response variability of preschool children. In general, it was found that preschool children preconditioned on a variable-reinforcement schedule were subsequently the most variable in their responses.

With the exception of the use of first-grade children in place of preschool *S*s, the present study was concerned with the same general area of research.

B. METHODS

1. *Apparatus*

The apparatus for preconditioning the *S*s has been described in detail elsewhere (1). Essentially it consisted of a "slot machine" placed at the end of a straight runway 15 feet long and 4 feet wide. The machine was modified to deliver a marble on predetermined schedules. A small chair was placed at the "start" end in front of an enclosed chamber housing a pulley-weight system. A leather child harness was attached to the pulley-weight system by means of a light strong wire which passed through a small hole in the chamber and snapped into a metal ring at the back of the harness. Concealed photoelectric cells at the "start" and "goal" ends of the runway stopped electric timers when *S* broke the beams. The apparatus used to quantify response variability has also been described in detail elsewhere (1). It consisted of a standard Foringer Marble Dispenser encased in a plywood frame in such manner as to conceal the marble hopper and to present to *S* only the plastic "payoff" dish. On the back wall of the plywood frame, concealed from the view of *S* by a black curtain, were four devices, a lever, doorbell button, chain, and drawer knob. These manipulanda were fixed to individual

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moveable fiberboard panels. Pilot lights on the back of each panel enabled *E* to record the device manipulated by *S*.

2. *Subjects*

Twenty first-grade children, 10 males and 10 females, were selected at random from the community and divided into 4 groups of 5 *S*s each, 3 experimentals and 1 control.

3. *Procedure*

The same procedure was followed as described in the previous study with preschool *S*s. All the experimental *S*s were experienced on the straight runway prior to exposure to the variability apparatus. One experimental group was placed on a fixed-ratio (FR), one on a variable-ratio (VR), and one on a regular-reinforcement (R) schedule. The control *S*s were exposed directly to the variability apparatus. Each child in the experimental groups received a total of 60 trials on the straight runway. Of the 60 trials, the first 30 were presented on a regular schedule and, while the (R) group continued on this schedule for the remaining 30 trials, the (FR-4) group continued on a schedule of one reinforcement for every fourth response, and the (VR-4) group continued on a schedule of one reinforcement, on the average, for every fourth response. The *S* was seated in the chair at the "start" end of the runway and was told to go to the "goal" end of the runway when the white pilot light went on at the end of the runway. The pulley-weight system was fitted with a one-pound weight and snapped to the leather harness. The *S* was instructed to pull the lever on the "slot machine" and if anything came out to put it in the metal box at the side of the runway, to return to the chair, watch for the light, and "play the game again." If nothing was received he was to touch the "payoff" tray, return to the chair, wait for the light, and "play the game again." Reaction time and running time were recorded. Following runway experience, the experimental group and the control group without this experience were exposed to the variability apparatus for 60 reinforced trials on a regular schedule. On this apparatus the *S*s were told to put their hand under the curtain and see whether they could "make the box work." If they obtained anything, they were to put it in the metal box at the opposite end of the room, return, and "work the box again." All manipulative devices were set to "payoff" a marble. The positions of the devices were "scrambled" by one *E* concealed behind the apparatus, while *S* was placing the marble in the metal box at the opposite end of the room. That *E* also recorded the device (or devices) used by *S* to obtain the marble. The children were given trials in blocks of five on each of four possible arrangements of the manipulanda.

At the termination of the study, each *S* was given a choice of a "take-home marble."

C. RESULTS

No significant differences were found between experimental and control *S*s in reaction times or running times on the straight runway.

Figure 1 shows the responses made on the variability apparatus by the four groups of first graders. Among the controls, it can be seen that two of the *S*s (40 per cent) were device stereotyped and used one device, consequently all four positions occupied by the device, to obtain the marble reward.

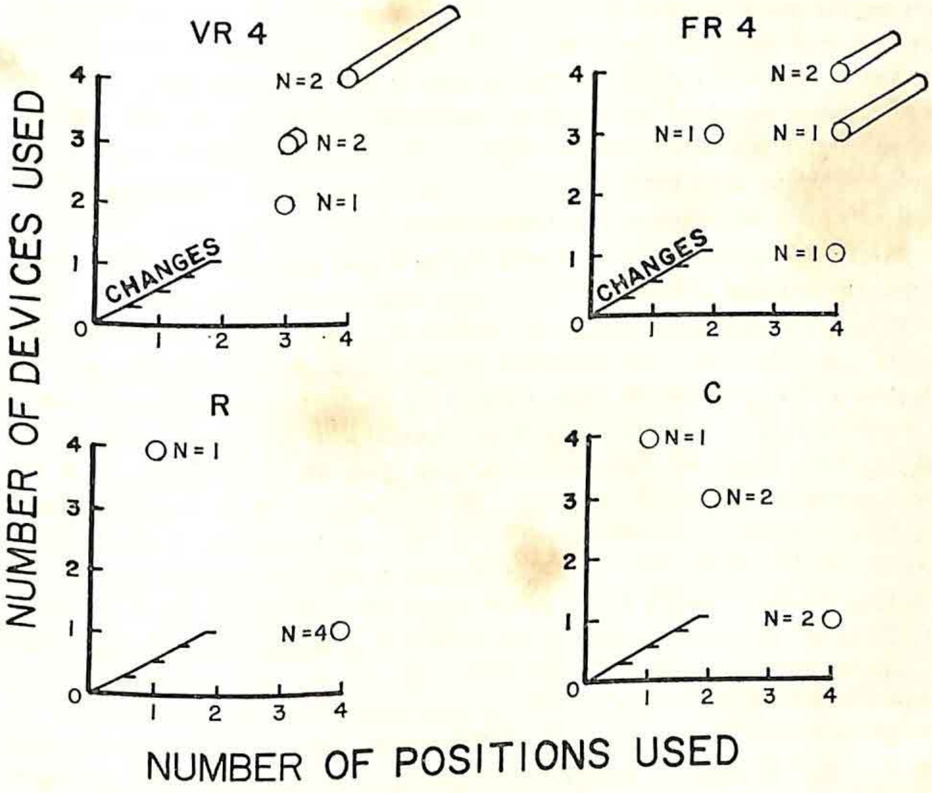

FIGURE 1
EFFECTS OF REINFORCEMENT SCHEDULES ON RESPONSE VARIABILITY IN FIRST-GRADE CHILDREN

One *S* (20 per cent) was position stereotyped and used whichever device happened to occupy the preferred position to obtain the marble reward. Two children (40 per cent) used more than one device and more than one position to obtain reinforcement. It was noted that device changes, although occurring between arrangements of manipulanda, never occurred *within* blocks of trials on any particular arrangement of the devices.

Figure 1 shows that 60 per cent of the FR-4 group used more than one device and more than one position to obtain the marble, and that manipulander changes did occur *within* as well as between blocks of trials on particular arrangements. In the case of 40 per cent of these *S*s, device changes occurred, on the average, 30 per cent of the time during blocks of five trials on the four arrangements of the manipulanda. In the case of one child (20 per cent), device changes occured, on the average, 55 per cent of the time during the five trials on the four arrangements of the devices. As Figure I shows, one child (20 per cent) in the FR-4 group used two positions and three devices to obtain the marble reward, but none of the device changes occured *within* particular arrangements of the manipulanda, but only between arrangements. It is evident that 20 per cent of the *S*s in this group were device stereotyped and used the same device to obtain the marble irrespective of its position in the arrangements of manipulanda.

Among Group-R children, Figure 1 shows that four (80 per cent) were device stereotyped and one (20 per cent) was position stereotyped.

Figure 1 shows that, among the VR-4 group of children, four (80 per cent) not only used more than one device and more than one position of devices to obtain the marble, but switched manipulanda *within* blocks of trials on different device arrangements. Two children (40 per cent) in this group changed devices on the average 87 per cent of the time during blocks of five trials on the four device arrangements. Two (40 per cent) of these *S*s changed devices on the average of 12 per cent of the time during blocks of five trials on the four arrangements of manipulanda. As Figure 1 shows, one of the children in this group (20 per cent), although using two devices and three positions to obtain the marble, never changed manipulanda *within* particular arrangements of devices.

D. Discussion

Screven (3), using a straight runway situation, similar to the one used in the present study, reported that "running time with first grade subjects does not appear to distinguish between different incentive levels at low work loads, but only at high work loads." Using one-pound loads we reported (1) that this statement was apparently not valid for preschool children since significantly faster running times were found for *S*s experiencing FR-4 reinforcement than for those on VR-4, R, or control schedules. In the present study, with first-grade children, Screven's statement is confirmed.

McCray and Harper (2) found that kindergarten children preconditioned under a VR-4-reinforcement schedule subsequently showed greater response variability than controls or children preconditioned under FR-4 or R schedules. In general, with some exceptions, we found this to be true when the *S*s were preschool children (1). It is of interest to compare the results of the present study, which involved first graders, with those of McCray and Harper (2) utilizing kindergarten children and with those of Benson *et al.* (1) involving preschool children. The former authors reported that all their controls were device stereotyped on the variability apparatus; the latter investigators found that 50 per cent of their preschool control *S*s were device stereotyped. In the present study 40 per cent of the control first graders were device stereotyped on the variability apparatus. It has been reported (1) that 37 per cent of preschool-children controls did manifest some variability, since they used more than one device and more than one position to obtain the marble reward. However, the "scope" of this expression of variability was reduced by the fact that device changes never occurred *within* but always between particular arrangements of the manipulanda. In the present study, 60 per cent of the control *S*s used more than one device and more than one position to obtain the marble reward and even though (as in the case of the preschool *S*s), this manifestation of variability was limited to device changes between rather than *within* arrangements of the manipulanda, it may be an indication of a trend toward increased variability as a function of age or school experiences.

In the present study, first graders preconditioned on a regular-reinforcement schedule were all either device or position stereotyped on the variability apparatus. The same characteristic was reported for kindergarten *S*s preconditioned on regular-reinforcement schedules (2) and for preschool children (1).

It has been reported that kindergarten, and preschool children (1, 2) preconditioned under FR-4 schedules failed to manifest marked response variability subsequently. However, results of the present study show that 60 per cent of the children preconditioned on FR-4 schedule subsequently exhibit considerable response variability, since they not only used different devices and different positions to obtain the marble reinforcement, but changed devices a high percentage of the time *within* the blocks of five trials on particular arrangements of the manipulanda. Comparatively, this appears to be a significant finding warranting extension of the study to children beyond the first-grade level.

McCray & Harper (2) and Benson (1) found that, with kindergarten and preschool children respectively, those preconditioned on a VR-4 schedule were subsequently more variable in their responses than any of the groups in the present study. The results of the present study, particularly in terms of the number of device changes within blocks of five trials on the four arrangements of manipulanda, agree well with the above findings.

E. Summary

Twenty first-grade children were divided into four groups of five *S*s each for the purpose of studying effects on subsequent response variability of the prior experiences of fixed-ratio, variable-ratio, and regular-reinforcement schedules.

Similarities and differences between responses of first graders, used in the study, and kindergarten and preschool children, used in previous similarly designed studies, are discussed.

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COLOR-MOOD ASSOCIATIONS IN YOUNG CHILDREN*

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A. INTRODUCTION

Wexner (3) and Odbert, Karwoski, and Eckerson (2), have found a relationship between mood tone and color choice among college students. Wexner gave students lists of adjectives and then instructed them to choose one color that they associated with the adjective list. With a group of adjectives, such as despondent, dejected, unhappy, and melancholy, the color chosen with the greatest frequency was brown. With a list, such as cheerful, jovial, and joyful, the color chosen with the greatest frequency was yellow. Wexner found no sex differences.

Odbert, Karwoski, and Eckerson also employed adjectives and several colors and obtained results similar to those of the study by Wexner. Yellow was most frequently associated with lists that contained adjectives such as playful, gay, and exciting; and brown was most frequently associated with lists containing adjectives such as solemn and sad. As in the Wexner study, no sex differences were found. Thus, it appears that college-age individuals associate the color brown with a "sad" mood and the color yellow with a "happy" mood.

The striking agreement between the findings of Wexner (3) and those of Odbert, Karwoski, and Eckerson (2) raises the question of what factors contribute to the association of colors with mood tones. Guilford (1) has suggested that among individuals there is a basic communality of color choices that rests upon biological factors "since it is hard to see how cultural factors could produce by conditioning the continuity and system that exists." No studies have tried to evaluate Guilford's theory by testing for the presence of color-mood associations in young children. Evidence that color-mood associations, similar to those found in the studies using adults, exist in preschool children would be evidence in support of Guilford's theory. Children of preschool age have been exposed to a minimal amount of cultural conditioning and thus would not be expected to have strong color-mood associations if those associations are based solely upon cultural conditioning.

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The purpose of the present study therefore is to determine if, when a method appropriate to their level is used, nursery-school children will associate color with moods.

B. Procedure

1. *Subjects*

The subjects consisted of 27 female and 21 male nursery-school children at the University of California, Harold E. Jones Child Study Center, Berkeley, California. The children ranged from 3 years and 3 months of age to 4 years and 6 months of age. The mean age of the children was 3.7 years.

2. *Apparatus*

Apparatus consisted (*a*) of two crayons, one brown and one yellow; (*b*) of mimeographed sketches of a girl wearing a dress—the girl's clothing and features were uncolored; and (*c*) two short stories as follows:

"Sad" Story

> This little girl is sad today. She's sad because her little puppy dog has died. She won't see him anymore. He's all gone and the little girl is so sad that she's crying. Don't you feel sad for the little girl?

"Happy" Story

> This little girl is happy today. She's happy because today is her birthday. She is going to have a big birthday party and all her friends are going to come over to play games. Then they are going to have birthday cake, ice cream, candy and cookies; isn't that exciting! Don't you feel happy for the little girl?

3. *Procedure*

The subjects were randomly divided into two groups. One group ($N = 26$) was told the "sad" story and the other group ($N = 22$) was told the "happy" story.

The subjects were tested individually. The experimenter took each child from the nursery-school situation and attempted to establish rapport with the child while accompanying him to the experimental room. The experimental room contained two small chairs and a table. The experimenter seated herself in one chair at the table and asked the child to be seated in the other chair.

The experimenter brought the child's attention to the picture of the little girl and said, "See this girl here. She is very happy [sad] today." The experimenter then continued with the appropriate story. After the story was over the experimenter brought the child's attention to the crayons and asked the subject to name the colors. The experimenter then asked the subject which of the two colors the girl's dress should be because she is happy [sad]. The experimenter then recorded the subject's response.

C. RESULTS

Chi-square tests for any possible sex differences in color-mood association were made. No significant sex differences were found to exist. Since there were no significant sex differences the frequencies for both sexes were combined for further study.

Table 1 presents the data concerned with the colors selected by the "happy" group and those selected by the "sad" group. For Table 1, χ^2 is equal to 5.19 which is significant at .025 level of confidence, with the "sad" group preferring brown and the "happy" group preferring yellow.

TABLE 1
DISTRIBUTION OF THE COLOR CHOICES OF "SAD" AND "HAPPY" GROUPS

Group	Color chosen Yellow	Brown	Total
Happy	14	8	22
Sad	8	18	26
Total	22	26	48

D. DISCUSSION

The results of the present investigation are in agreement with those obtained by Wexner (3) and with those of Odbert, Karwoski, and Eckerson (2). Significant trends showing brown associated with a sad mood and yellow associated with a happy mood were found, but no significant sex differences appeared. The fact that preschool children who have been subjected to relatively little cultural conditioning have strong color-mood associations similar to those found in adults gives some support to Guilford's theory that color choices are biologically determined. Of course this finding does not rule out the possibility that cultural conditioning plays an important role in determining color-mood associations since even children of preschool age may have been subjected to some cultural conditioning in this area.

It is interesting to note that the method of mood induction, though strikingly different from those used in the previous studies, provided the same color-mood relationships. Thus it appears that color-mood association is not an artifact of one experimental procedure or subject type, but is a phenomenon that can be obtained with several experimental methods and with male and female subjects of varying ages.

E. Summary and Conclusions

An experiment was conducted to determine if color-mood associations exist in nursery-school children. The children were divided into two groups and one group was told a "happy" story and the other group was told a "sad" story to induce the moods. The children were then given a choice of a yellow and a brown crayon to use for the color of the girl's dress in the story. For the "happy" group, yellow was chosen most frequently and for the "sad" group brown was chosen most frequently. No significant sex differences were found to exist. It was concluded that color-mood associations exist in nursery-school children.

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ANIMISTIC THOUGHT IN CIVILIZED ADULTS*

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A. Introduction

The term "animism" was originally used by anthropologists for the characteristic of primitive thinking that led the primitive to attribute a number of what we should consider as natural events to the activity of spirits [*see* Tylor (12)]. When Piaget studied children's philosophies and their conception of the world, he also used the term "animism" and defined it as "the tendency among children to consider things as living and conscious" (6, p. 537). He put forward the view that "child animism is the result of a confusion or rather lack of differentiation between the psychic and physical," and that with increasing age the child "grows out of his initial animism" (6, p. 538). Piaget also said that a "child is animist to the extent to which he confuses the inner and the outer, the psychic and the physical. And it is when, between eight and ten, he becomes conscious of the existence of thought and of its inwardness, that he ceases to be animist" (6, pp. 538-539). The development of animistic ideas, in Piaget's view, is from a first stage when "everything is alive" (6, p. 537) to a final stage when "the child reserves life to animals and plants, or even to animals alone" (6, p. 538). This final stage is sometimes called "naturalism."

In applying the concept of animistic thinking to a stage of children's mental development, there is no doubt that Piaget was making a useful and important contribution to the understanding of the development of the intellectual life of children. However, it may reasonably be doubted whether the matter is as simple as Piaget's treatment of it would lead us to suppose. Later research, and reflection on the linguistic process of categorization may make one suspect that the stages are less clear-cut and inevitable than Piaget thought, and also that attributing animism to a "confusion" may rest on a mistaken idea of the necessity for a discrimination being made along what is conventionally assumed to be the correct adult line.

First one finds that what Piaget would regard as evidence of animistic thinking may also be found among adult students. The developmental stages

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identified by Piaget have been studied by Russell and Dennis (7) using questions suggested by Piaget: "Is the *A* living?" "How do you know?" "Does the *A* know where it is?" and "Does the *A* feel when it touches something?" each asked of 20 objects. Although Russell considered that "it is probable that individuals pass sequentially through the series of concept stages with increasing mental and chronological age," he also said that the "data have revealed the impossibility of limiting the age range of the stages as Piaget has attempted to do" (8).

Dennis was surprised to find that, "in the absence of specific instructions, 'educated' persons in modern societies possess many conceptions of the world that are identical with those of the child or of the uneducated" (1). He found that the students he studied not only used the word "living" as equivalent to "active" or "moving" but also attributed consciousness to objects. He concluded that "anthropomorphism is not limited to children" (1). It does not seem possible to escape the conclusion that adult subjects, as well as children, may show the characteristics of animism. No doubt there may have been uncertainty among Dennis's subjects about the use of the words "alive" or "living," but is not this uncertainty the essential linguistic aspect of what Piaget meant by "animism"?

Some animistic thought is similar to certain kinds of schizophrenic thinking (in adults) in which conventional categories are misapplied or linguistic boundaries have broken down: e.g., Searles (10). Such evidence from schizophrenic thought suggests that the development from animism to naturalism may be a reversible process. In a statement similar to one by Piaget, Kubie says ". . . every symbolic unit hangs like a hammock between two poles, one internal or bodily (the 'I') and one external (the 'non-I')" (5).

One cannot suppose that all animistic thought in adults is either immature or regressive, for Dennis's results show that about one third of his college subjects made a use of language which seems to imply animism. It may be the case that there is a real difference between the students studied by Dennis, which students perhaps were using animistic language in a metaphorical way, and the children who are presumed to be using it because they are unable to apply conventional categories. The fact remains that the observable linguistic behavior of the students was of the same kind as that from which the presence of animistic thinking is deduced for children. It is also within one's everyday experience that many adults who are not schizophrenic show behavior that seems to imply animistic thinking, when, for example, they act *as if* certain inanimate objects have some animate or personal characteristics. They may behave with respect to certain things that change without external intervention (such as a bush fire) as if they belonged to a special category—being neither inanimate nor properly animate. They may even treat some objects as if they were "possessed" or controlled by supernatural forces.

B. The Concept of Animism

It becomes less surprising that students may show some uncertainty as to the boundary between the animate and the inanimate when we find that animistic ways of thinking have been used by philosophers and scientific thinkers who are far from being immature or primitive. Old examples of this tendency to use animistic ideas are to be found in Kepler and Fechner [*see* Heim (4, p. 92)]. Fechner put planets and stars in the category of animate objects and regarded the Earth as a self-moving organism.

In more recent times, Whitehead has entertained certain animistic ideas. In *Science and the Modern World,* he referred to the gap between living and dead as "vague and problematical" (13, p. 111). To Whitehead, both the lifeless and the living had the character of organisms within which the constituent elements run their courses in ways determined by the total character of the organic structure to which they belong. This principle, he said, "is perfectly general throughout nature, and represents no property peculiar to living bodies."

In Dennis's enquiry, one of the grounds for diagnosing a subject's thought as "animistic" was his willingness to assert that the sea could "know" where sunken ships were lying. It is interesting to find that Eddington used similar "animistic" language when he said "an electron would not know how large it ought to be unless there existed independent lengths in space for it to measure itself against" (2, p. 155). If it is argued that Eddington was only speaking metaphorically when he spoke of an electron "knowing," he was certainly using language in a way that would be regarded as diagnostic of animistic thinking by a psychologist making a test of thought processes. It is also to be noted that Eddington took the consideration of what the electron could "know" sufficiently seriously to make it the ground for a deduction—that space occupied by matter must have a finite radius of curvature.

The most recent and the most definite use of animistic ideas by a scientific philosopher is found in the work of Teilhard de Chardin who argued against the view that consciousness is restricted to the higher forms of life and concluded, from the appearance of consciousness in man, that it must have a cosmic extension (11, pp. 55-56). Chardin was also able to quote J. B. S. Haldane in support of this view: "We do not find obvious evidence of life or mind in so-called inert matter . . . but if the scientific point of view is correct, we shall ultimately find them, at least in rudimentary forms, all through the universe" (3, p. 113).

The use of animistic ideas by thinkers of the rank of Whitehead, Eddington, de Chardin, and Haldane suggests that such use is less irrational than is commonly supposed. One may indeed consider that the principles that determine the discrimination underlying any categorisation are not inflexible. It is not self-evident that the line must be drawn where, for example, the biologists draw it. Certainly we should expect that a student trained in the biological sciences would agree that a tree and a snake are living and that a fire and a stone are nonliving since he has been trained to categorise in this way. Dennis's enquiry shows, in fact, that even this expectation will only be partly fulfilled; biological students did not always conform to the conventional classification of living and nonliving although a larger proportion did so than among those nontrained in biology.

It remains true that there is nothing necessarily primitive in the classing together of tree, snake, and fire among the animate. In many respects, the behavior appropriate to a fire and to a snake has more in common than has the behavior appropriate to a tree and to a snake. Both the fire and the snake are free-moving and unpredictable in their movements; both can be deprived of activity (made "dead") by appropriate activity on our part. There is nothing absurd in putting a fire in the class of the living. There is no one right system of categorisation. The criteria adopted for categorisation depend on linguistic training, on the practical purpose for which the categorisation is made, and on the experience and environment in which life is lived.

One of the authors (L. B. B.) had the opportunity of studying animistic thought among aboriginal children at Coober Pedy in the Far North of South Australia. It seemed that their replies depended upon an understanding of the way in which the word "living" was to be applied. It also depended on characteristics of their environment. For example, the few trees in their neighborhood were dead trunks; so "trees" were classified by some of them among the nonliving.

The different ways of making the discrimination between the living and the nonliving may be regarded as applications of different criteria of animateness. The convention of asking questions about objects may not be the best way of obtaining the most useful data, either because of a deficient coverage in the list (for example, Dennis's omission of plants) or because the instructions are inadequate. To ask whether a thing is living or not living without specifying the criteria that he is to adopt leaves to the subject the critical question of the definition of "living." The subject may have chosen some way of classifying objects that appears to him more important than the biological discrimination between the living and the nonliving. He has not been specifically instructed to adopt the conventional biological categorisation, yet for the evaluation of results this is treated as the one correct "adult" type of response.

C. New Experiments

What has been said in the previous section suggests the desirability of using a method of obtaining data about animistic ideas that allows greater freedom to the subject to express himself than does even Dennis's modification of previous methods. With a revised technique, it becomes possible to consider the conditions under which objects that we should ordinarily regard as inanimate may be treated animistically (including retaliatory behavior), and possible also to study the differences between uses of the terms "dynamic," "living," and "moving." In addition, one can explore the characteristics that are used as criteria of living things, which may include such qualities as independence or deliberateness of action as well as the conventional biological characteristics of respiration, reproduction, and so on.

To determine the extent to which different frames of reference may be adopted in determining whether a set of things is alive, 12 second-year students were asked whether "a lighted match, the sun, the ocean, clouds, sea, lightning, wind, stars, and the earth" were alive. All except two of them said that they were not alive, their answers including ". . . do not reproduce . . . ," ". . . dynamic, but don't reproduce and don't grow . . . ," ". . . not in the sense of living matter . . . ," ". . . no, although earth and ocean may include biological material . . . ," ". . . not metabolic or organismic growth . . . ," ". . . no senses and no life cycle as in plants and animals . . . ," ". . . movement but no life . . . ," ". . . I've done biology . . . ," and ". . . not in the normal sense, although energy could somehow be involved."

However, of these 10 people, three sought to make an exception of the lighted match, one by saying that "alive" was here a play upon words, and another by saying that "it depends on how 'alive' is used."

Of the two who replied that the things in the list were alive, one said he was "concerned with a living force, either chemical or physical" (suggesting that this person may have been influenced by the thought of modern physics) and the other said they involved a "constant state of change, involving fusion and interaction of a variety of elements." No information is available about the academic training or other beliefs of these people, but clearly judgments of "alive" are not made in isolation from one's thought about the world at large and the rest of one's training. It is also clear from these results that when judgments of "alive" are made for the objects in such a list as this, this judgment is not made naively. Rather than the answers showing an inability to make proper distinctions, they seem to show a high degree of sophistication in the distinctions made.

To explore further the kinds of distinction that are made, a technique of open-ended enquiry was employed. The subjects were 50 second-year students, and they were given the following instructions:

> Write a list of as many different kinds of thing as you can think of that are living.
>
> Write as many different kinds of thing as you can think of that are not living.
>
> Write a list of things that might equally well be classed as living or as not living.
>
> What are the main characteristics that distinguish what is living from what is not living?
>
> Does one ever behave towards nonliving things as if they were living? If you have answered "yes" to this question, give a few examples.

Because the aim in analysing the responses was not to show the frequency with which various kinds of response were given, but rather to show how far the responses were conventional and the kinds of elaboration that were found, the results will not be treated metrically. The open-ended form of the questions moreover makes quantification of the results difficult.

In the list of things that are living, the majority gave classes of objects, although a few produced lists of specific members of classes. These latter replies have been grouped with their appropriate class. The most frequent classes given were animals, people, plants, fish, bacteria. Infrequently mentioned classes were mollusca, protozoa, trees, insects, birds, reptiles, termites, fungi, yeasts and moulds, lichens, and algae. Five people emphasized that plants and animals were alive "while they are still growing" and only three people gave idiosyncratic replies. One of these included fairies, gnomes, elves, and pixies; another wrote hair, nails, and skin; while the complete list of a third was insects, mammals, animals, God. It may be concluded that all the responses to this section conformed to conventional criteria, with the exception of the very occasional inclusion of mythical creatures.

The second section asked for a list of things that are *not* living. In the responses here, only strictly conventional categories were employed, including stones, earth, water, air, material (e.g., cotton), dead bodies (corpses), flowers that have been picked, metal objects, air, and petrol. Moon, sun, and stars were mentioned by a few; and the complete list of one person was furniture, transport, buildings, clothing, equipment. Another wrote solid material—metallic and nonmetallic—liquids, gases, and their infinite combinations.

The third section concerned "things that might equally well be classed as living or as not living" and was designed to elicit those things about which there is some ambiguity. There were four people in the sample who said that nothing fell in this category, while another was undecided. Typical replies were "virus," "cells, fungus, coral, mould, bacteria," "trees," "vegetables," "plant life," "Supernatural things, including God, spirits," "wind, rain, sun, heat, fire," "hair and skin," "atoms and electrons," "plankton," "ships, etc., attributed with living characteristics."

The responses in this section can be grouped into three broad classes, the smallest being of those things to which some animateness is attributed. The next group includes those things about which biologists are uncertain, such as viruses and supernatural forces. Finally there are various kinds of vegetation which have some but not enough of the conventionally accepted characteristics of those things that are living.

The responses to the question about the characteristics that distinguish the living from the nonliving showed a high degree of uniformity. The most commonly mentioned characteristics were reproduction, metabolism, growth, respiration, and the ability to move, in that order. Other less frequently mentioned criteria included "will not last forever," sensitivity and responsiveness to stimuli, can manipulate the environment, and unpredictability. "Having a nervous system" was given as a criterion by two subjects, and one said that the nonliving is "passive and acted upon." Most of the answers showed tentativeness in the criteria that were suggested, and all gave some essentially biological characteristic to define the difference between the living and the nonliving. It will be recalled that the primary problem was not to differentiate what is living from what is not living, but to know how to specify intermediate categories.

The final question concerned the circumstances in which nonliving things are treated as living. There were seven people who said that this never happened, while another said that he was doubtful about it. Those who said that nonliving things were sometimes treated as living things were asked to give examples. The most frequent examples referred to children playing with their toys (e.g., "children giving life to dolls") and to various religious practices (e.g., "worshipping of gods," "idols," etc., or simply "statues of saints"). Other frequent examples were photographs, paintings, and "cursing inanimate things," with "prized possessions" (such as car, boat, etc.) given by three people, and "calling an object by name" and "departed friends," each given by two people.

Infrequently mentioned things were moon (in poetry), sentimental gifts, letters from home, mountains and the sea, rain, dead pets, fetishes, pianos, tennis racquet, money, books, bacteria, worship of trees.

A few additional comments were offered, one subject observing that the attribution of life happens "if one projects one's thoughts into objects"; another, that "all natural objects should be treated with a certain respect, depending upon the nobility of the object"; another, that "nothing should be wantonly destroyed"; and another, that "some take more care over plant life than over animal and human life."

It seems clear from these responses that, rather than any intrinsic property of the object forcing an animistic response, it is those objects that have acquired significance for the individual that are expected to be treated by him as if they were animate. Such animistic behavior patterns cannot be attributed to immaturity or to a confusion of categories, but should rather be regarded as products of an essentially deliberate process.

D. Conclusions

With the use of a closed-question technique, Dennis has argued for the "naive character of most (animistic) replies," citing the example of a lighted match as living "because it has flames which indicate life." He also said that animistic answers cannot "correctly be considered poetry, philosophy, whimsy or science" (1). The present investigation shows, however, that if a series of open questions is asked about the things that would fall into various categories, students can and do make the "correct" distinctions between living and nonliving. They know how a biological classification is made, yet they agree that one sometimes acts *as if* inanimate objects possessed some of the properties of the animate. This *as if* behavior is not based on the biological characteristics of life, but on the fact that certain inanimate objects have some of the characteristics of the fully living. Thus the action of the wind can be interpreted as if it were of the same kind as, for example, the behavior of a snake.

This ascription of some of the characteristics of life to the inanimate appears too widespread to be attributed to immaturity or to a confusion of categories. Adult animism must be distinguished from child animism since adult animism is reversible, although there may well be continuous gradation from the irreversible animism of the child to the reversible animism of the sophisticated adult. There does not, however, seem to be in the use of the concept of the "living" merely a single direction of development from children to adults in which the categorisation becomes increasingly "correct": i.e., in conformity with biological use. Such correctness may also be attained by children if they are suitably taught, and there is no reason for supposing that it has not been attained by adults who use animistic categories. Rather it appears that there is an additional direction of development in which the use of the category becomes increasingly flexible in the adult. There may be occasions when adult thought is facilitated by the use of animistic categories, particularly when (for example) unpredictability and apparently autonomous movement are involved. The use of animistic categories may facilitate the handling of some problems by overcoming the limitations that language imposes, as do the use of myth and of symbolism. There is clear need for further study of the conditions under which inanimate objects may be treated animistically and of other ways in which flexibility of thought can be achieved.

It is concluded, therefore, that the students of our sample (without significant exception) are able to give the conventional biological answer to a question about the criteria of "living." When confronted with a list of objects to which various responses can be given, they do not give animistic replies without the introduction of qualifications which cut across the simpler divisions. It is clear from the two studies here reported that the use of animistic categories by adults may be a result of choice and not of an inability to make the conventional discrimination between the living and the nonliving.

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COLLEGE STUDENTS' JUDGMENT OF THE PASSAGE OF TIME OVER THE LIFE SPAN*

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A. INTRODUCTION

Data from studies requiring subjects to estimate objective clock time (usually intervals of less than two or three minutes) or to describe time by the use of swift or static metaphors suggest that the perception of time may be influenced by a number of factors: e.g., age (2, 13); type of activity (4); emotional state (1, 8); motivation (3); outlook on the future (2); personality structure (6); and value of time (13).

The present study requires individuals to rank the age periods in life in terms of the quickness of the passage of time. Under these conditions, some of the factors just mentioned may be more relevant than others; still others (such as sex, marital status, social class, health, and personal and social adjustment) may have even greater relevance. One important factor may be the individual's attitude toward aging. In western culture, there is an overemphasis on youth accompanied by a corresponding underestimation of age. The negative attitude toward aging was demonstrated in several studies that show substantial agreement in the misconceptions and stereotypes about old people and the older worker. These studies have been based upon responses secured from children as young as 11 years of age (7), from undergraduate (12) and graduate (13) students, from middle-aged nonprofessional workers and their wives (12) and from retired men and women living in their own homes or in institutions for the aged (9, 10). These findings suggest the hypothesis that the ranking of the age periods with respect to the passing of time as fast or slow will be influenced by the negative attitude toward aging.

B. PROCEDURE

The procedure involves the ranking of age periods in life with respect to the passage of time from most quickly to most slowly and the giving of reasons for the selection of the quickest and the slowest periods. The life span

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was divided arbitrarily into eight periods, with the youngest period as "up to 12 years" and the oldest, as "70 years and over." There is general acceptance of childhood as equivalent to "up to 12 years" and of adolescence as equivalent to "13 to 19 years." Beyond 20, however, no such semantic equivalences exist. In the absence of better justification, the age span beyond 20 was divided into decades. The directions used and the method of presentation are shown below:

> Directions: Time passes more quickly for people at certain periods of their lives than at others. Below are eight age periods. Pick out the period in life when you think time passes most quickly and write the number 1 after it; then pick out the period which takes second place in this respect and write the number 2 after it; and so on until finally you write the number 8 after that period in life when you think time passes most slowly.
>
> up to 12 years____________
> 13 to 19 years____________
> 20 to 29 years____________
> 30 to 39 years____________
> 40 to 49 years____________
> 50 to 59 years____________
> 60 to 69 years____________
> 70 years and over_________
>
> For the period you marked number 1, please give the reason. For the period you marked number 8, please give the reason.

The questionnaire was administered to 150 undergraduate students (80 men and 70 women) enrolled in classes in psychology or sociology at the University of Pennsylvania. The group ranged in age from 17 to 24. The mean age was 20.1 with a standard deviation of 1.6 years.

C. Results

The mean ranks showed significant sex differences for three of the eight age periods, but the direction of the differences was not consistent. Moreover, the correlation (rho) between the mean ranks for men and women was .98. Without exception, the standard deviations were lower for women than for men, suggesting less difference of opinion in the rankings among women. The greater consistency of women in the ranking of the age periods was also evident by the magnitude of the coefficient of concordance, W,[1] used to get an estimate of the amount of agreement among the students. The coefficient of concordance was .52 for women and .26 for men, both significantly different from zero. The distribution of the rankings of the periods judged as passing most quickly, of those judged as passing most slowly, and of the reasons for each judgment showed no significant sex differences. Although the variability in the rankings was greater for men than for women, the data suggest no essential sex differences. Therefore, results are reported only for the total group.

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[1] A large W indicates a high degree of agreement while a small W indicates a low degree of agreement. For a large number of judges as in this study ($N = 150$), W is approximately equivalent to the average intercorrelation among the judges. The average intercorrelation among judges $= (mW - 1) \div (m - 1)$ where m is the number of judges and W is the coefficient of concordance. As the number of judges increases, the average intercorrelation approaches W (5, p. 411).

The overwhelming proportion of the students, 85 per cent, selected early childhood (up to 12 years), adolescents (13 to 19 years) and the 20s as periods when time passes most quickly (see Table 1), although there was division of opinion about early childhood. By contrast, 70 per cent of the group selected the 70s and over as the period when time passes most slowly. The mean ranks, also given in Table 1, show a gradient characterized by improvement to a peak (most quickly) in adolescence followed by a steady decline for successive age periods. The gradient seems similar to obtained age curves for strength of grip, auditory acuity, and visual acuity (in the physiological area) and for rate of learning (in the psychological area).

TABLE 1

The Per Cent of Undergraduate Students Selecting Each Age in Life as Passing Most Quickly and Most Slowly

	Age period								
Choice	Up to 12	13-19	20-29	30-39	40-49	50-59	60-69	70 and over	*W*
Most quickly	23	43	19	2	3	5	0	6	.37
Most slowly	17	5	1	1	1	1	3	70	
Mean rank	3.8	2.7	3.0	3.9	4.4	5.2	6.1	7.0	
SD	2.5	2.2	1.7	1.1	1.3	1.4	1.6	2.0	

The reasons given for selecting age periods as passing most quickly were broadly classified into the following categories:

1. *Activity and new experience:* e.g., "The more active a person is the less conscious he is of time and therefore time seems to pass more quickly." "Many changes, therefore time passes quickly."
2. *No responsibilities:* e.g., "Having few responsibilities and few exposures to the pressures around him, it would seem that to a young child, time passes most quickly." "There are relatively few worries that a child has if he is in fairly good health."
3. *Faulty time perception:* e.g., "For the first few years, there is little awareness of time."
4. *Personal experience:* e.g., "Because I am in that age range, I can think back (I am 19) to when I was 13 and 14 and it seems like yesterday." "As I grow older time seems to pass more quickly."
5. *Establishment:* e.g., "These are the years when one enters occu-

pations, gets married, begins having children." "You have reached the stage in life when decisions regarding the future must be made. You are leaving home and establishing yourself."

6. *Time running out:* e.g., "They feel they are closer to death and therefore time seems to pass to quickly." "Not so long to live." "Every person I have met who is over 70 remarks how fast the days go by. There never seems to be enough time. They want to hold on to every day."
7. *Other:* e.g., "Time when goal drive is strongest." "Because it is further in the past."
8. *Not stated or indefinite replies.*

Activity and new experience was given as the reason for time passing most quickly by 39 per cent of the students, establishment by 12 per cent, personal experience by 11 per cent, no responsibilities by 11 per cent, faulty time perception by 11 per cent, time running out by nine per cent, and other reasons by five per cent. One per cent of the students did not answer the question or gave indefinite replies. The reasons varied with the age period selected. Students selecting early childhood as passing most quickly gave reasons oriented around faulty time perception and no responsibilities. Those selecting adolescence shifted markedly to reasons stressing activity and new experience; just a small proportion mentioned no responsibilities and personal experience. Those selecting the 20s gave reasons related to establishment, with less emphasis upon activity and new experience. For the approximately one in six selecting age periods beyond the 20s, the reasons stressed time running out.

The reasons given for selecting periods as passing most slowly were classified into the following categories:

1. *Inactivity and lack of interests:* e.g., "You are inactive and time is a burden." "Inactivity drags out the days." "Has nothing to occupy his mind."
2. *Waiting to die:* e.g., "I should think that time would pass very slowly while waiting for death." "At this period of life, a person is ready to die and like a death sentence, the time for it approaches very slowly."
3. *Sickness and old age:* e.g., "You will probably be sickly, therefore time will pass slowly." "One is old and unable to do many things."
4. *Loss of adult roles:* e.g., "This is a passive period in life—retirement; perhaps the person's mate (if he or she is married) is deceased; children are not around; much idle time." "You have no family to take care of and you might be out of a job so time goes slow."
5. *No future:* e.g., "Just hanging on with no immediate goals." "You have really nothing to look forward to. You have accomplished all you can, you are getting ready to pass from life and life holds little new excitement but just the running out of your own." "What does one have to look forward to at age 70?"

6. *Personal experience:* e.g., "This was the worst period of my life and consequently seemed to go slower." "That period of time seemed endless."

7. *Waiting to grow up:* e.g., "Most teenagers can't wait until they are adults and thus time seems to drag." "At this time a person is waiting for the societal maturity age of 21 and the period seems to go slowly because it is one of waiting."

8. *Activity and new experience.*

9. *Faulty time perception.*

10. *No responsibilities.*

11. *Establishment.*

12. *Other:* e.g., "This is middle age where events are relatively static." "This is close to the end of your life and there is plenty of time for reflection." "Because you are conscious of your age; and when you look back you think time is moving fast."

13. *Not stated or indefinite replies.*

Inactivity and lack of interests was given as the reason for time passing most slowly by 29 per cent of the students, sickness and old age by 13 per cent, waiting to die by 10 per cent, loss of adult roles by seven per cent, no future by six per cent, activity and new experience by six per cent, waiting to grow up by five per cent, personal experience by three per cent, faulty time perception by two per cent, no responsibilities by one per cent, establishment by one per cent and other reasons by eight per cent. Eight per cent of the group did not answer the question or gave indefinite replies. As was found for periods judged to pass most quickly, the reasons varied with the age period. For the approximately one in six students selecting early childhood as passing most slowly, the reasons stressed change and new experience; personal experience and waiting to grow up were mentioned less frequently; and faulty time perception and no responsibilities least frequently. It should be noted that about two-thirds of those selecting early childhood as passing most slowly mentioned activity and new experience, faulty time perception and no responsibilities (the same reasons that were given by some students for selecting early childhood as the period for time passing most quickly). The very small proportion of students selecting adolescence as the slowest period gave reasons related to waiting to grow up. For the approximately three in four students selecting the 60s and older, inactivity and lack of interests was given as the reason most frequently; sickness and old age and waiting to die less frequently; and loss of adult roles and no future least frequently.

D. CONCLUSIONS

Undergraduate students differ in their perception of the passage of time over the life span. The early years are seen as passing quickly and the later years as passing slowly. Early childhood is regarded as a period of faulty time perception and no responsibilities; adolescence as a period of activity and new experience; the 20s as a period of establishment (in job, family, and community); and the 70s and over as a period of inactivity and lack of interests, sickness and old age, waiting for death, loss of adult roles, and no future. The shifting in the way different age periods are regarded by the students appears to be a function of their own age, life experiences, and the cultural expectations of age-role behavior.

However, the favorable position accorded the youthful years and the increasingly unfavorable position accorded the middle and later years, evident in the ranking of the age periods with respect to the speed of the passage of time as well as the reasons for time moving quickly or slowly, is indicative of a negative attitude toward aging and the aged.

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PARENTAL IDENTIFICATION OF LATE ADOLESCENTS AND LEVEL OF ADJUSTMENT: THE IMPORTANCE OF PARENT-MODEL ATTRIBUTES, ORDINAL POSITION, AND SEX OF THE CHILD*

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A. Introduction

To theories of child development, the explanatory importance of the concept of parental identification is undeniable. Despite the theoretical inconsistencies evolving from differing definitions and interpretations of the process (1, 16, 22), most observers of childhood behavior agree that something occurs within the context of the family that leads to a degree of behavioral similarity between a child and one or both parental models. It is generally assumed that for the normal development of the child the primary identification is with the parent of the same sex, although a degree of cross-sex identification in normals is expected (2). If parental identification holds such central importance in mediating normal childhood development, then specifying the conditions under which identification occurs may also shed light upon the genesis of behavioral disorders in childhood and adolescence, by clarifying the nature of deviancy in identification learning. The purposes of the present investigation were to relate selected parent model and child variables to identification learning and to determine whether different relationships obtain at varying levels of child adjustment.

The present study focused upon two variables that seemed to bear considerable relevance to the identification process and upon the sex of the child as it might interact with these variables. For one, sex typicality of the parental model should be important because the stereotyped behaviors of males and females in the American culture differ in many respects (2), a situation sustained by social rewards and punishments that accrue for sex-appropriate and sex-inappropriate behavior. Although there is evidence that the sex roles are currently in flux (2), it would still be expected that boys are more likely to be rewarded for modeling themselves after masculine fathers than after a more feminine model of either sex. The case for the female is less clear,

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since studies have shown that the male role is the more highly esteemed one in our culture and that cross-sex behaviors are better tolerated for females than for males (2, 17, 23). Three investigators (6, 7, 24), in fact, have reported evidence suggesting a maternal identification to be maladjustive for females, but none considered masculinity-femininity of the model as a variable. The implication for adjustment is that identification with an inappropriate parental model should mediate behaviors in the child that are in conflict with the stereotypical values of his social group.

The ordinal position of the child in the family bears upon identification to the extent that the order of birth dictates the types of familial milieu in which he will come to be exposed to the parental models. Sears, Maccoby, and Levin (23), in a study of kindergarten-age children, have suggested several distinguishing characteristics of being born first or later in the child sequence. For one, mothers tend to regard their first children more positively than later ones. Also, mothers spend less time in nurturant interaction with each child as the number increases. Fathers, on the other hand, also spend more time in interaction with first children than with those who follow. Since identification has been shown to be related positively to degree of nurturance of the same-sex parent (18, 19, 20), it might be expected that first girls will be more strongly identified with their mothers than are later girls, since they alone have the experience of relating to the mother at a time when she is most likely to provide them greater nurturance and more opportunity for interaction. It might also be expected that first boys would have a more difficult time making an identification with the father for the same reasons and remain more highly identified with their mother than do later boys. However, the greater interaction of fathers with first children complicates such a prediction, since it can be contended that this would enhance the opportunities for the boy to pattern himself after his father.

The implications of ordinal position for eventual maladjustment are not obvious for either sex. First girls should be more identified with their mothers, yet the adjustive consequences of a feminine identification for females are not clear, as just mentioned. The positive adjustive values of a masculine identification for a boy are more certain, but whether first boys will be more or less identified with their fathers is uncertain. Empirical answers to these questions were sought in this study.

Although the importance of the developmental stage at which the model attribute, ordinal position, and sex variables are related to identification and adjustment level was not investigated in this study, some significance can be attached to whether such relationships can still be demonstrated some 20 years after birth. Because the major effects of the parental identification process upon the child's behavior are probably completed before this time, demonstration that the nature of identification in the late adolescent still bears a relationship to familial variables and current adjustment should enhance our confidence in the explanatory value of the concept.

B. Method

1. *Adjustment Level of Subjects*

The basic pool of subjects employed in this study consisted of 523 undergraduates at the University of Iowa. They were divided by level of current adjustment into maladjusted (M), slightly maladjusted (SM), and adjusted (A) groups, as defined by having sought help for personal problems (M), or vocational-educational problems (SM) at a college counseling center, or as those who had not applied at this service for psychological help (A). Both personal experience and empirical evidence (4) suggest clear-cut adjustment differences between groups selected in this fashion, although it can be assumed that almost all *S*s in the study fall within a broadly normal (nonpsychiatric) population.

The specific numbers in each group for males are M = 71, SM = 90, and A = 138; for females, the figures are M = 70, SM = 115, and A = 139.

2. *Measures of Developmental Variables*

Type and degree of identification was measured by a scale that reflects the perceived similarity between the child and his same-sex parent, as provided by the child. Norms for the Identification Scale [see (7)] have been developed for college students so that, along a wide spectrum of personality dimensions (e.g., achievement need, nurturance, dominance, aggression), a score of $T = 50$ represents the average perceived similarity between the son or daughter and the same-sex parent. A score above 50 indicates identification with the same-sex parent. A score below 50 indicates cross-sex identification.

Masculinity-femininity of the parental model was measured by providing the subjects with behavioral descriptions of the 15 traits that entered into the Identification-Scale scores. They were asked to judge whether these types of behaviors were more descriptive of their mothers or of their fathers. Based upon the rating of 400 college students (12), nine of the 15 traits were previously shown to be sex typed for parents. The model score for the same-sex parent was obtained by determining the number of traits (out of these nine) for which the relative judgments were consistent with stereotype. For males, fathers were expected to be more need achieving, autonomous, dominant, to show greater endurance, and to be less deferent, affiliative, succorant, abasing, and nurturant. The reverse pattern was scored as sex typical for the mothers of females. Scores ranged from zero to nine, with low scores indicating sex atypicality (i.e., a masculine mother or a feminine father) and high scores indicating sex typicality (i.e., a feminine mother or a masculine father).

Four ordinal positions were defined for this study. Only children, oldest children in a family of at least two children, middle children in a family of at least three children, and youngest children in a family of at least two children. Only and oldest children were considered separately (despite the common characteristic of both being first children) because of the important difference that the latter group developed in the context of additional siblings. Unfortunately, sibling information was not obtained from the A subjects; accordingly ordinal-position analyses were run only for the SM and M groups.

C. Results

1. *Parent Model Attributes, Identification and Adjustment*

Extreme-group statistical comparisons were used to increase the probability of finding relationships between the model attributes of parents and identification. High-masculine fathers and high-feminine mothers were those whose model scores were eight or nine. Low-masculine fathers and low-feminine mothers had model scores falling between zero and five.

The relationships between masculinity-femininity of the same-sex parental model and identification at three levels of adjustment are given in Table 1. As the parental model-identification relationship is considered for the various levels of adjustment, a clear pattern emerges for each sex. For males, greater identification with the high-masculine-father model for A subjects merges into no difference in identification between high- and low-masculine-father models for SM subjects which, in turn, merges into stronger identification with the low-masculine-father model for M subjects. In the case of females, A adolescents identify more strongly with the low-feminine mother, SM subjects show no pattern of identification as a function of model attributes, and the M subjects tend to identify most highly with high-feminine mothers.

These results were analyzed statistically in two ways. First, the differences in same-sex parental identification scores for the A subjects having stereotypically appropriate and inappropriate parent models were analyzed. As indicated on Table 1, there is a significantly greater identification with the high-masculine father for males and with the low-feminine mother for females.

By *t* tests for interaction (i.e., difference between the differences), the sec-

TABLE 1

Relationships Between Masculinity-Femininity of the Same-Sex Parental Model and Identification at Three Levels of Adjustment for Late Adolescents

	Degree of identification of sons to fathers							Degree of identification of daughters to mothers						
	High-masculine father			Low-masculine father				High-feminine mother			Low-feminine mother			
Level of adjustment	*N*	Mean	*SD*	*N*	Mean	*SD*	*t*	*N*	Mean	*SD*	*N*	Mean	*SD*	*t*
Adjusted	41	53.9	13.3	47	48.3	10.0	2.25*	31	48.4	11.5	42	53.7	9.7	2.11*
Slightly maladjusted	32	49.3	11.2	28	49.1	9.4		31	51.0	10.5	41	49.2	9.8	
Maladjusted	21	46.5	4.7	17	50.1	10.9		16	60.2	14.2	32	51.0	10.4	

* Significant at $p < .05$.

ond type of statistical test compared the model-identification relationships for the adjusted groups with those for each of the malajusted groups. For group A, the male pattern of higher identification with high-masculine fathers than with low-masculine fathers does not differ reliably from the pattern for the SM subjects ($t = 1.39$ for 144 *df*; $p > .10$), but does vary significantly from the pattern for the M group ($t = 2.14$ for 122 *df*; $p < .05$), the members of which identify more with low-masculine fathers. For females, the A-group pattern of higher identification with low-feminine mothers differs reliably from the SM pattern ($t = 2.03$ for 141 *df*; $p < .05$) and even more reliably from the M pattern ($t = 3.36$ for 117 *df*; $p < .001$).

2. *Identification and Ordinal Position of the Child*

Since *F* tests failed to show any differences by ordinal position in the patterns of identification between the SM and M groups for either sex, these adjustment groups were combined for the ordinal-position analyses. The degree of identification with the same-sex parent for male and female adolescents as a function of birth order is given in Table 2. The findings for males suggest that only-child status results in a higher identification with the mother (i.e., a lower father-identification score) relative to any other ordinal position. The statistical comparison for males of the only-child mean (45.3) with the mean (49.1) for children with siblings approaches significance at the 10 per cent level of confidence ($t = 1.75$ for 141 *df*). This near-significant result assumes more importance when it is considered that all of the male ordinal-position groups tend toward a lower paternal identification than college males in general, thereby providing a truncated array of identification scores and probably increasing the difficulty of group discrimination. Only-child status for females does not appear to influence maternal identification (50.6) when

TABLE 2
DEGREE OF IDENTIFICATION WITH THE SAME-SEX PARENT FOR LATE ADOLESCENT MALES AND FEMALES AS A FUNCTION OF ORDINAL POSITION

Ordinal position of child	Degree of identification of sons to fathers			Degree of identification of daughters to mothers		
	N	Mean	*SD*	*N*	Mean	*SD*
Only	22	45.3	11.9	21	50.6	8.1
Oldest	55	49.0	9.9	72	54.7	10.6
Middle	30	49.0	6.0	31	50.5	11.2
Youngest	36	49.3	8.5	45	48.6	11.2

related to the identification (52.0) of female children with siblings ($t = .54$ for 167 *df*; $p > .50$).

Ordinal position of children *with* siblings appears important for females but not for males. Oldest daughters are more highly identified with their mothers (54.7) than middle and youngest daughters combined (49.4), the difference being highly significant ($t = 3.05$ for 146 *df*; $p < .002$). The almost identical degree of identification of oldest sons (49.0) and combined middle and youngest sons (49.1) to their fathers obviates a statistical test of the difference.

Parenthetically, inspection of the data suggest no higher-order-identification interactions of parental model by ordinal position by adjustment level. That is, within the limits of our current measurements, the distinct patterns of identification found at the various levels of adjustment do not vary from one ordinal position to another.

D. Discussion

To adolescent adjustment, the importance of the type of parental model with which the child identifies is clearly indicated by the present study. As predicted, the psychologically more adjustive pattern for sons is the identification with a more masculine father. It is shown that as identificatory tendencies shift to the use of less masculine father models, the probability of disruptive behavior problems increases. Partial interpretation of these findings, as offered previously, is in terms of selective social reinforcement for masculine behaviors in males. When male adolescents, in the course of making the difficult transition from childhood to adult-role expectancies, experience the additional stress of social nonreward or punishment for feminine personality attributes, it is not surprising that the frequency and extent of maladjustive behaviors is increased. Two emotional correlates of negative social reinforcement for nonconformity to masculine stereotype should be heightened anxiety and frustration. In two previous studies (8, 13), Heilbrun has provided evidence that these disruptive emotional qualities exist in the male adolescent whose manifest behaviors fail to conform to socially-imposed requisites.

The results for females are no less significant, but are more surprising in that greater adjustive value accrues to an identification pattern that runs counter to the usual sexual stereotype. That is, identification with a less-feminine mother is associated with the best adjustment, whereas increasingly poorer adjustment is found with the use of more-feminine maternal models by adolescent girls. It is noteworthy though that the A and M girls differ only slightly in the extent to which they identify with low-feminine mothers. The major difference is in the much-higher identification of the M group with the high-feminine mothers. This finding may be regarded as a more precise specification of the general relationship between maternal identification in girls and poorer adjustment reported in three previously cited studies (6, 7, 24) in that maladjustment is related to identification with only the *highly feminine* maternal model.

Johnson (14) has recently proposed that masculinity and femininity are best distinguished by what Parsons (21) has described as an instrumental *vs.* an expressive orientation. Femininity involves an expressive orientation characterized by attempts to "please" in the sense of eliciting rewarding responses from others by virtue of providing them rewarding responses. Expressiveness implies a sensitivity and a responsiveness to the attitudes of others. Masculine instrumentality requires that the person transcend the immediate positive and negative emotional reactions to him, because his orientation involves pursuit of future goals. Social interactions tend to be seen as means to an end. Such a distinction between masculinity and femininity proves useful in interpreting both the male- and female-parent model-identification findings. It would suggest that both male and female adolescents with masculine instrumental orientations are better adjusted in a competitive college environment in which the competitional aspects require some imperviousness to peer response while distant goals of graduation and vocational success are being pursued. Conversely, a more feminine, expressively oriented adolescent would experience greater difficulties in meeting the demands for sustained need achievement, independence, and competitive disregard for others—demands that are instrumentally important for academic success.

Several studies bearing upon the male personality correlates of overachievement and underachievement in college (3, 5, 10) attest to the importance to college success of high instrumental-low expressive behaviors, such as high need achievement, high endurance, low nurturance, and low affiliation; in another study (9) it was shown that feminine-identified males were more confused regarding achievement values than masculine-identified males. However, other studies of female college students argue against a simple application of the instrumental-expressive distinction as a factor in adjustment. In one study (10), academic underachievement in females was found to be related to a variety of behaviors indicating *low* expressiveness (e.g., aggressiveness, autonomy, exhibitionism, and low deference); in another unpublished study of first-year college dropout by Heilbrun (11), high-ability girls who failed to make the initial college adjustment were also characterized by behaviors of a less expressive nature than their "stay" counterparts. A tentative conclusion that would embrace this apparent contradiction is as follows: males with an orientation primarily instrumental are doubly reinforced (and better adjusted) because they conform to masculine stereotype and because this orientation is more effective for college success. College females who *combine* instrumental and expressive behaviors (mixed identification) tend to adjust, whereas those who conform to or tend to deny femininity by high- or low-expressive orientations experience adjustive difficulties. Further, it seems reasonable to propose the girl's identification with a masculine mother as the basic paradigm for achieving a mixed identification, whereas identification with a feminine mother or masculine father may promote a high- or low-expressive orientation, respectively.

The present investigation indicates that ordinal position of the child continues to show demonstrable effects upon parental identification of the child up through the late-adolescent stage. The effect is similar for both sexes. Being the first and only child for the male or the first and oldest child for the female is associated with an enhanced identification with the mother. Apparently, the greater maternal nurturance with the first child or the temporary experience of having an exclusive maternal model promotes an early and continuing identification for the child. The failure to have an adjusted sample for the ordinal-position analyses restricts the safety in generalization, however. It can be contended, for example, that children who show these patterns of identification as a function of birth order are those who have adjustment problems, and that adjusted adolescents would provide a different pattern or no pattern at all. About the only answers available within the confines of the present study are those that imply that no significant pattern differences exist between slightly maladjusted and maladjusted subjects and that there was some *a priori* basis for expecting the results obtained.

E. Summary

The present investigation was concerned with the relationships between parental identification and (*a*) masculinity-femininity of the parental model and (*b*) the birth order, sex, and adjustment level of the child.

Three levels of adjustment are defined for college males and females. Adjusted males tend to identify with more-masculine father models, but this changes to a greater identification with less-masculine fathers as more seriously maladjusted subjects are considered. Adjusted female adolescents identify most with low-feminine mothers, but this pattern is reversed for more-maladjusted females.

Ordinal position relates to identification in a more restricted way. Only-child males are more highly identified with their mothers than are males with siblings. Oldest girls are more strongly identified with their mothers than are middle and youngest children.

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AGE CHANGES IN THE EFFECTS OF ORDINAL POSITION ON SEX-ROLE IDENTIFICATION*[1]

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A. INTRODUCTION

In recent research on ordinal position, first-born children, when compared with later-born children, have demonstrated higher achievement (1), stronger affiliative drive (26), greater curiosity (16), conscience (28), and dependency (27). There are additional characteristics that have been mentioned in other studies, but in these latter studies (as in so many of those surveyed by Jones in 1931 (14), there has been no control exercised for the differences in family size that are likely to coexist with comparisons of the first and later born. A higher proportion of non-first born are likely to come from large families. This means that there is no assurance that the differences that have been found are not, in part, due to other correlates of family size—in particular, to the inverse relationships with socioeconomic status and intelligence and, perhaps, to rural-urban or ethnic differences. There is, however, a certain construct consistency between the findings mentioned above and those of other less well controlled studies. Thus, it has been demonstrated that first borns, when compared with later borns, have higher need achievement (24), internalize more (20), volunteer (6), conform (2), and affiliate (25). Unfortunately, however, confounding effects appear across some of these less well controlled studies. In some studies, first borns react as predicted from Schachter's work (2, 25), but in others they do not. Sometimes it is first-born men who react in a fashion that reverses predictions (9, 11) and sometimes it is first-born women (24).

These inconsistencies in the data may be due to the lack of sampling controls or they may be due to a theoretical flaw in the research. Generally, it has been inferred, for example, that the differences between first and later-born children are due to certain primary socialization experiences that presumably are universal in western culture: for example, the special attention given by mothers to the anxieties of their first born (26) or their incompetence in

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feeding techniques (27). On the other hand, it is possible that the foregoing primary socialization techniques are not as widespread as has been assumed, or that their influence can be countermanded by subsequent secondary socialization influences. It is notable that, in the earlier review by Jones (14), there is no mention of attempts made to explain ordinal-position differences in terms of primary socialization. Traditionally, it has been assumed that first-born children, especially males (as in primogeniture), receive specialized acculturative pressure throughout their development. And in recent work, Sampson (24) has also found it necessary to include the secondary socialization variables of responsibility and independence training to explain some of the incongruities in his data. In sum, until there is more evidence it would appear wise to give more theoretical attention to the continuous nature of the interaction between ordinal position and child training and to the specific effects of the siblings upon each other throughout child development, as Lasko (19) has done.

The sources of present contradiction appear to lie (*a*) in the same sorts of sampling inadequacies that invalidated most of the earlier studies—in particular—lack of control for age and family size; (*b*) in the categorization together of all first borns as compared with all later borns, when there is already evidence that the distinctive types of first borns (F1F, F1M, M1M, M1F) vary as strongly among themselves as do second borns (FF2, MF2, MM2, FM2), though there also may be distinctions between the two broad categories in two-child families (17, 22); and (*c*) in the present lack of theoretical understanding of the way in which primary and secondary socialization variables interact to produce specific ordinal-position effects. It is unlikely, for example, that adults today place the same conscious importance on male first bornness as historically has been the case in western culture or as is still the case in some traditional cultures. To what extent any continued proclivity of mothers and fathers for first-born males leads to systematic acculturative influence in western culture is at present unknown. Ordinal position usually is not thought of as a status variable, like sex or age, customarily associated with pressures toward specific types of social learning. But this type of specific pressure cannot be ruled out (3, 24). By and large, present-day effects of ordinal position are such as to *facilitate* or to act as a *barrier* to the varying reinforcements that are available to a child at different age levels.

The present study deals with the interactions between ordinal position, age, and sex-role identification in the context of a theoretical position that involves both primary and secondary socialization variables. Two earlier studies reviewing ordinal position at age 6 (15, 16) and at age 10 (22) are compared with data derived from the present study of 20-year-olds. By confining the study to one-child and two-child families, and by controlling for age and socioeconomic status, the criticisms levelled at the other studies mentioned presumably have been avoided. Tentatively, the following postulates are offered as a first step toward a more adequate theoretical model for ordinal-position data. This model is restricted by the present sole concern with ordinal position and sex-role identification (or more strictly, sex-role preference). The postulates are as follows:

1. that the effect of ordinal position changes with the reinforcement values that are most important at the different age levels: in particular, at 6 years, those provided by the mother; at 10 years, those provided by the same-sex peers; and at 20 years, those associated with masculine prestige.
2. that, for both sexes at 20 years, male sex-role preferences have greater reinforcement value than female sex-role preferences.
3. that, in consequence, sex-role preference patterns are more consistent throughout childhood for boys than for girls.
4. that mothers and fathers act not only as agents of reinforcement for different models, but the models that they provide for their children change as the children develop.
5. that mothers have stronger and continuing reinforcement value for first borns because of the conflict-induced dependency of those in that ordinal position.
6. that siblings reinforce their own sex traits in the opposite sibling irrespective of that sibling's sex.
7. that older siblings, because of their greater power, have a greater reinforcement value for younger siblings than vice versa.

Only the last two of the postulates refer strictly to ordinal position. With respect to ordinal position, they may be called the secondary socialization variables involving learning by reinforced interaction with a sibling. All the other postulates are more general and have implications beyond the study of ordinal position.

B. METHOD

In the previous studies, the results of which will be compared with those of the present study, measures of masculinity, femininity, anxiety, and impulsivity were employed. In the earlier study of 6-year-olds (15, 16), a reanalysis of the Koch data by Brim (4) provided the masculinity-femininity measures. The measure of anxiety was derived directly from a composite of Koch's teacher ratings (15, 16). The study of 10-year-olds (22) used self-report measures of masculinity-femininity (21), impulsivity (30), and anxiety (7). While it is admitted that the use of different assessment devices and different samples introduces variations that might vitiate the comparisons to be given between age levels, the consistencies in the data suggest that the various measures tap the same dimensions at the different age levels.

The present sample consisted of 93 men and 160 women from the sophomore introductory psychology course at a Midwestern State University. The sample contained 21 M, 21 M1M, 19 M1F, 16 FM2, and 16 MM2; 32 F, 32 F1F, 44 F1M, 24 MF2, and 28 FF2. This notation simply states the sex and position referent. The number following the subject indicates his ordinal position, which position is also indicated by the position of the subject's letter in the sequence. Thus, F1M is a female with a younger brother; MM2 is a second-born boy with an older brother; M refers to an only male child, etc. The groups of subjects do not differ in age (range: 18 to 30 years) by sex, or by ordinal position ($\text{Median}_B = 19$; $\text{Median}_G = 19$). It should be noted that 95 per cent of all ordinal groups are in the 18-to-20-year age range. The various groups do not differ significantly on socioeconomic classification and are predominantly lower-middle to middle class. On a manual-nonmanual split for each category, there are no significant differences among the various ordinal groups.

Each subject indicated his ordinal position by completing a sheet requesting his name, age, sex, sex of sibling, age of sibling, and parent occupation. For the present analysis, the size of the N precluded control for age distance between self and sibling.

To obtain measures of masculinity-femininity (Mf), anxiety (MAS), and impulsivity [psychopathic deviate (Pd), hypomania (Ma)], the Minnesota Multiphasic Personality Inventory (13) was administered to all subjects. All protocols about which there was question (as reflected in the validity scales of the MMPI) were eliminated.

C. RESULTS

1. *Scores by Sex and Ordinal Position*

In view of the volume of data, only those data directly relevant to the questions at hand and achieving significance beyond the .05 level of confidence will be examined. In a preliminary analysis involving F tests for each scale in relation to the several ordinal categories, six results were significant for males but only one result was significant for females.

Table 1 presents the mean scores of the ordinal groups for each of the MMPI scales. Several findings are salient. First, in terms of the normative

TABLE 1
MEAN MMPI SCORES BY SEX AND ORDINAL POSITION

Ordinal position	*N*	L	F	K	Hs	D	Hy	Pd	Mf	Pa	Pt	Sc	Ma	Si	MAS
				Scale on the Minnesota Multiphasic Personality Inventory											
M	21	2.71	3.76	13.00	51.24	56.19	53.76	56.17	63.19	52.43	57.24	56.52	62.43	51.00	15.28
M1M	21	1.95	3.86	14.05	53.33	54.90	57.86	58.05	61.52	52.14	60.19	58.60	62.62	47.62	15.33
MM2	16	2.50	3.25	15.50	50.25	51.44	55.31	56.69	60.25	52.63	55.06	54.38	59.00	47.75	11.18
M1F	19	2.00	5.58	13.42	52.21	55.84	55.68	60.05	62.47	54.47	63.10	62.95	67.95	49.53	16.89
FM2	16	2.19	7.38	13.44	56.63	58.06	58.69	62.62	67.37	60.88	66.81	68.75	67.43	52.19	18.69
F	32	2.45	3.72	13.66	52.16	49.59	59.28	56.62	46.81	55.28	58.66	56.12	62.18	51.18	19.34
F1F	32	2.47	3.56	14.47	48.66	51.62	54.34	52.22	45.16	50.40	58.28	56.53	55.00	56.44	18.28
FF2	28	2.89	3.50	15.21	49.89	49.93	55.96	54.61	47.61	53.82	55.32	55.79	58.00	60.61	17.79
F1M	44	2.20	3.39	15.34	52.96	51.93	56.73	56.75	46.82	54.16	57.39	57.43	58.34	49.80	18.43
MF2	24	2.08	2.38	16.12	49.92	48.75	55.46	51.42	48.33	52.38	56.75	54.46	58.21	48.83	15.46

data on college populations (10, 12, 34), the males tend to vary more as a group than do females. Even the more extreme-scoring girls are well within the normal range; whereas the extreme-scoring boys, particularly those with an older sister (FM2), show a highly deviant profile. In general, boys with sisters (first or second born) yield a more deviant profile than do boys with brothers. Boys with sisters differ significantly from boys with brothers ($p <$ .05) on the masculinity-femininity (Mf), depression (D), manifest anxiety (MAS), and psychopathic (Pd) + hypomania (Ma) scales, and tend to have higher scores on the other scales, also. The FM2-class yields more deviant profiles than the M1F-class and may be characterized as having excessive concerns about physical welfare, depression, anxiety, impulsive acting-out tendencies. Its members are sensitive, shy, seclusive, and feminine, and have a feeling of being misunderstood (e.g., significantly elevated hysteria (Hy), depression (D), manifest anxiety (MAS), hypomania (Ma), masculinity-femininity (Mf), psychasthenia (Pt), and schizophrenia (Sc). On these scales, from poorest to best (emotionally), the order of performance is FM2, M1F, M1M, M, MM2. There are no significant differences for the several male ordinal groups on the lie (L), test-taking attitude (K), and Social (Si) scales.

All the female ordinal groups are well within the normal range on the MMPI, with groups F and F1M being the most deviant. The order of performance for girls is F, F1M, F1F, FF2, MF2. The least feminine but most stable on all dimensions is the MF2 group. The only-girl is the most impulsive, acting out, and anxious. Along with F1M, the only-girl is high on bodily complaints, the use of denial and repression, complaining, etc. [e.g., hypochondriasis (Hs), hysteria (Hy), psychopathic deviate (Pd), paranoia (Pa) and hypomania (Ma)]. On most of the scales, these girls have higher scores than the F1F, FF2, and MF2 groups.

Thus, the boy with the older sister presents the most deviant MMPI profile, while the girl with the older brother appears to be the most stable female. Again, whereas the only-boys (M) appear in a highly favorable light in terms of the total MMPI configuration, the only-girl (F) seems less favorably disposed in adulthood.

2. *Age Comparisons*

Table 2 presents the rank order of members of the several ordinal classes by age for masculinity, femininity, and anxiety. The data for the 6-year-olds is derived from Koch (15, 16) and Brim (4); and those for 10-year-olds, from Rosenberg and Sutton-Smith (22). The following results obtain: Re-

TABLE 2
RANK-ORDER POSITIONS OF THE VARIOUS ORDINAL GROUPS ON MEASURES OF MASCULINITY, FEMININITY, AND ANXIETY FOR 6, 10, AND 20 YEARS

Rank order	Boys 6	Boys 10	Boys 20	Girls 6	Girls 10	Girls 20
			Masculinity			
1	MM2	M1M	MM2	MF2	F	MF2
2	M1M	M[a]	M1M	F1M	MF2	FF2
3	M1F	MM2	M	FF2	F1F	F1M
4	FM2	M1F	M1F	F1F	FF2	F
5		FM2	FM2		F1M	F1F
			Femininity			
	6	10	20	6	10	20
1	FM2	M	FM2	MF2	FF2	F1F
2	M1F	M1M	M1F	FF2	F1F	F
3	MM2	FM2	M	F1F	F	F1M
4	M1M	M1F	M1M	F1M	MF2	FF2
5		MM2	MM2		F1M	MF2
			Anxiety			
	6	10	20	6	10	20
1	M1F	M	FM2	F1F	MF2	F1M
2	M1M	M1M	M1F	F1M	F1F	F
3	FM2	FM2	M1M	FF2	F1M	F1F
4	MM2	M1F	M	MF2	FF2	FF2
5		MM2	MM2		F	MF2

[a] M (only-males) and F (only-females) were not included in the Koch data for 6-year-olds.

gardless of ordinal position, and at all ages, boys with brothers have higher masculinity scores than boys with sisters. Girls, however, do not show the same uniform picture on masculinity at all ages. The exception is the second-born girl with an older brother (MF2), who scores very high on masculinity throughout. By ordinal position and sex of sibling, no consistent pattern holds for the other female groups.

The trends for femininity scores are less consistent. Nevertheless, the presence of an opposite-sex sibling for boys generally leads to higher femininity scores, although at the age of 10 M and M1M are exceptions. Generally, girls with sisters tend to be more feminine, though (once again) girls are more variable across the age levels than are the boys.

For both sexes, anxiety measures appear more variable than masculinity or femininity measures. At age 6, being a first-born child of either sex is accompanied by higher anxiety. At age 10, anxiety is a correlate of highest opposite-sex characteristics, so that those who score most highly on the opposite-sex scales also score most highly on anxiety (M, M1M, FM2, MF2, F1F). At age 20, regardless of ordinal position, males with sisters are most feminine and anxious. Second-born children are less anxious throughout the age levels, just as they tend to be more consistent on masculinity and femininity measures. The notable exception is the FM2 group.

D. Discussion

Before proceeding to a theoretical examination of our findings, it seems desirable to present various reasons why they do not seem easily explainable in response terms. The response-set approach suggests that it is feminine to admit to feelings and, therefore, to score higher on the various anxiety scales. The responses on the MMPI are mainly within the normal range; so the only factors under scrutiny are normal variations of masculinity and femininity.

Our reply is twofold. First, the normal variations correlate with the appropriate same- or opposite-sex siblings across the various age levels and show clearly the effects of the sibling's ordinal position on the subject's masculine or feminine scores. This is the case when the masculinity and femininity scores are derived from self-report measures (at 10 and 20 years) and when taken from teachers' ratings (at 6 years). Second, there is considerable evidence to show that the higher anxiety scores are not simply feminine expressions (although they are also that), but are symptomatic of emotional conflict. From the MMPI, there is the internal evidence associating these anxiety scores with other measures of emotional conflict: for example, the performance on the psychopathic deviate (Pd) and hypomania (Ma) scales, which scales usually are not thought to involve any particular feminine-response set. Also, at the age of 10 there is considerable evidence (from the correlation of the anxiety with the impulsivity measures) that conflict is involved. Further, these anxiety and impulsivity measures have been shown to be related to other indices of emotional conflict (23). Scores on emotional conflict are not scores on sex-role conflict, but when they vary logically with masculinity or femininity measures, which on other grounds (such as inconsistency with sex-role expectations) might be thought to be conflict-inducing, then there is cogency in considering such measures as indications of sex-role conflict.

The conceptual schema that guides the interpretation of the age-change data in the present research is as follows. The interactions between the subject and sibling, or between the subject and parents, constitute the independent variables. These interactions have different effects according to age because, at different ages, the subject is seeking different reinforcement values. Thus, the ordinal interactions can act to facilitate access to these values or can act to impede such access. At age 6, the dominant value is access to the major-reinforcing agent, the mother. Children whose access is impeded by the mother's greater attention to the infant child (i.e., the first born) are more in emotional conflict than those who have ready access (second borns). At age 6, anxiety is considered a first-order dependent variable, directly responsive to this interference or to the lack of it. Masculinity and femininity, however, vary independently of anxiety, at age 6. Masculinity and femininity are dependent variables, so that boys with brothers are more masculine, and boys with sisters are more feminine. But these dependent variables are not related to anxiety as a dependent variable. At 6, the anxiety scores express the effects of sibling's ordinal *position,* while the sex-preference scores express the effect of the sibling's *sex*. By the ages of 10 and 20 years, this picture has changed. Major reinforcements are then provided by one's same-sex peer group, and the subject's masculinity or femininity is instrumental to obtaining these reinforcements. If the subject's sibling, through the latter's interactions with the subject, heightens or depresses this masculinity or femininity (making those traits consistent or inconsistent with dominant sex-role values), then he facilitates or makes more difficult the subject's access to those values. Therefore, at 10 and 20 masculinity and femininity are conceived as being first-order dependent variables (because they are a direct result of the interactions between the siblings), and anxiety and impulsivity are conceived as being second-order variables (because, it is presumed, they occur as a result of the inappropriateness of the masculine or feminine traits acquired through interaction with one's siblings). The picture is obviously more complex, but the data establish the fact that the sex of the sibling has a definite effect on the sex preferences of the subject and, if such effects are inappropriate, the subject's anxiety and impulsivity scores are also affected.

This interpretation implies that, by the age of 10, there is a tendency for the sex of the subject and that of the subject's sibling to become more important than the ordinal position of the subject, whether first or second born. Thus, at age 10 (regardless of ordinal position), those who have opposite-sex characteristics heightened by the presence of an opposite-sex sibling tend to be more in conflict. In other words, as children move into preadolescence, the peer-cultural emphasis on appropriate sex-role characteristics begins to vie in importance as a reinforcer with the earlier influence of the mother. There is some anthropological data suggesting that in American culture (8) such collateral values continue to be important throughout life. With age, the increasingly reinforcing value of masculine traits in the general culture decreases the sex-role conflict for those ordinal positions that bring the subjects into contact with male siblings. This postulate (5) seems necessary to explain the relative-rank advantage in terms of lower anxiety held by subjects who have male siblings as compared with subjects who have female siblings. The consistency of boys' preferences throughout development may also be explained in terms of the greater prestige value of masculine preferences in western culture. There is also other evidence of the vacillating nature of girls' sex-role preferences throughout development (18, 32, 33).

Various postulates about the parental role have been necessary to explain, in particular, the behavior of only-children and of some of the first-born children. Thus, first-born children and only-children show less consistency across the age levels and, at 20 years, have a higher membership in the high-anxiety ranks than do second-born children. These arguments have been considered in an earlier paper (22). Here, all that needs to be added is the fact that the improvement of the only-boy's position and the deterioration of the only-girl's position, from age 10 through 20, seems explicable most simply in terms of the foregoing postulate involving males prestige.

The distinctively ordinal postulates have been referred to a number of times. In brief, siblings reinforce their own sex traits in the opposite sibling, irrespective of that sibling's sex. When that sibling is also in a lower power position (as MF2 and FM2 are), the relationship is simple. Thus, the girl with an older brother has her femininity lowered and her masculinity increased; the boy with an older sister has his masculinity lowered and his femininity increased. Likewise, MM2 and FF2 have their own sex traits heightened. All of these second-born groups (except second-born boys with an older sister) appear to prosper by the vicarious reinforcement available from their older sibling; that is, they have low anxiety scores. This value, however, once again interacts with the overriding importance of masculine prestige to make the position of the FM2 a deviant one. Up to this point, the notion of interactive reinforcement, or "assimilation" [Brim (4)] is straightforward. At age 20, the heightening effects of sex-role preference as a result of interaction with a member of that sex are also noticeable. The interactive reinforcement can be considered to occur regardless of the power of the other siblings. In the earlier paper (22), however, it was shown that at age 10 the opposite-sex sibling could have a conflict-inducing as well as an interactive effect upon the subject. This was indicated by a heightening of sex preferences not only for the sibling's sex, but in some cases for the subject's sex.

The foregoing postulates, which explain ordinal position and sex-role preference effects in terms of interactions between siblings, parents, ordinal position, ordinal sex of subject, and age-relevant values argue strongly against simpler interpretations in terms solely of primary socialization factors. It seems probable that equally complex explanations involving both primary and secondary socialization variables are required for an understanding of ordinal position effects on such personality variables as affiliation, conformity, and achievement. An important implication of the present work is that personality is strongly affected by the nature of one's position in the family and by the sex of one's siblings. While it is impossible to say at this point how strong the sibling influence is, as compared with the parent's influence, it is clear that the matter is now open for debate. The present paper strongly supports a general social matrix (parents, *cum* siblings, *cum* peers) view of the origins of social development and counteracts the exclusive attention customarily given to the role of the parents.

As a final point, however, we would once again remind the reader of the important limitations of a cross-sectional study, both in respect to the comparability of measuring techniques and in respect to sampling across age levels. It is hoped that a later analysis of some of the available longitudinal studies may provide the necessary test for some of the age-change suggestions introduced in this paper.

E. SUMMARY

Criticisms are presented of much recent research in ordinal position on the grounds that there has not always been control for family size and that there has been an overemphasis on the explanatory value of primary socialization variables in interpreting the behavior of persons in different ordinal positions. It is suggested that secondary socialization variables of a general cultural sort, as well as of those specific to ordinal interactions, are necessary to an adequate understanding of ordinal-position effects. The present paper investigates the effects of ordinal position at age 20 in two-child families in a sample of 253 college students in terms of their responses on the MMPI scales. Comparisons are made between the different ordinal positions at age 20 and with data from previous investigations at the ages of 6 and 10 years. The comparisons involved measures of masculinity, femininity, and anxiety analogous to those contained in the MMPI scale. In general, the results suggest that anxiety is greater at 6 in first borns, at 10 among those who have inappropriate sex-role characteristics, and at 20 years among those who have higher femininity scores. Thus, ordinal position seems to be important at age 6, but the sex of the sibling is more important at ages 10 and 20.

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GROUP-OPERANT BEHAVIOR: REINFORCING EFFECTS OF PURE TONES AND OTHER SOUNDS ON THE BAR PRESSING OF PRESCHOOL CHILDREN IN A REAL-LIFE SITUATION*[1]

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A. INTRODUCTION

In a series of observations made (during the 1960-1961 academic year) of the reinforcing effects of tape-recorded vocal statements on the bar-pressing behavior of a group of 22 youngsters in a nursery school, the author included 15 days of observations of the effects of two-second pure tones of 1000 and 250 cycles per second. The observations indicated that, in contrast with the strong reinforcing effects of vocal statements, the 1000-cycle tone appeared to have only weak and transitory reinforcing potential; and the 250-cycle tone, no apparent reinforcing potential (2). Subsequently, question arose as to whether the reinforcing effects of the pure tones would be more readily perceptible in the group operant data if the tones were made available as reinforcing consequences at the start of observations. The first purpose of this paper is to report the results obtained in a study designed to yield an answer to this question.

Following assessment of the reinforcing effects of pure tones, observations were continued with the same group of children to obtain a preliminary test of Woodworth's hypothesis that the reinforcement of perception is mediated by identification of the object character of the stimulus (3). For the test of Woodworth's hypothesis, several sounds were made available as consequences of bar presses by the group of preschool children over successive week-long periods. Two of the sounds used (namely, white noise and the amplified sound of a pencil sharpener) were selected in the belief that they would lack identifiable object character for the children. Three other sounds—that of breaking glass, that of a vocal statement, and that of a toy music box—were

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selected as probably identifiable by the children. The second purpose of this paper is to report the results obtained when these sounds, with and without apparent object character, were made available contingent upon bar presses by the new group of children in the real-life environment of a nursery school.

B. METHOD

1. *Subjects*

A total of 23 children, 12 boys and 11 girls, enrolled in the nursery school conducted by the Department of Psychology of the University of Maine during the 1961-1962 academic year were involved as subjects. On December 4, 1961, the date when the present observations were started, the group included nine boys and 10 girls (with one of the girls attending the school on Tuesdays and Thursdays only; and one of the boys, on Mondays, Wednesdays, and Fridays). Two of the girls had been present in the school during the prior year when the study using vocal statements had been carried out (2). One of these latter two youngsters withdrew on January 8, 1962, and the second left the group on March 8, 1962. On February 12, 1962, a new girl joined the group to attend on a regular daily basis and, on February 23, a new boy joined to attend on Tuesdays and Thursdays only. During the week of April 9, 1962, two more boys were enrolled: one to attend on Tuesdays and Thursdays and the other, on Wednesdays and Fridays. On May 7, 1962, the last date of observations covered in this report, the youngsters ranged in age between 47 and 74 months. All subjects involved were offspring of members (or of close associates of members) of the University community.

2. *Apparatus*

The bar-pressing unit and associated recording and control equipment used previously by Antonitis, Frey, and Baron (2) for presentation of auditory stimuli as reinforcers were used without modification in the present work. Briefly, the equipment included a 51 1/2″ tall, pedestal-like bar-pressing unit which was permanently situated against a long wall near one end of the 20′ by 45′ nursery-school room and faced open floor space normally used for active play. Mounted inside the unit at about face height for the youngsters and behind a cloth-covered wire screen was a loudspeaker. The response bar, a three-inch long, one-inch diameter wood dowel, was available at the center of an eight-inch square, four-inch deep plywood enclosure below the loudspeaker port at hand height for the children. The bar enclosure was fitted with a removable cover so that access to the bar could be controlled. Wires from the switch activated by the bar and from the speaker were led away from the bar-pressing unit via a conduit to a remote control room.

The sound stimuli, recorded on 32-inch-long loops of magnetic tape, were presented via the loudspeaker in the unit by means of an automatically activated tape player in the control room. Inherent in the system was a two-second delay between bar depression and start of reproduction of recorded material. Responses made while the tape was playing were counted electrically in the control room, but a response made only after the tape had played through would reactivate the system. Continued depression of the bar resulted in just one playing of the tape loop; the bar had to be released and depressed again for a second reinforcement. By proper timing of bar presses, up to 14.5 reinforcements per minute were obtainable. The delay between the bar press and onset of the auditory stimulus resulted in an average of six responses being made by *S*s for each reinforcement.

3. *Procedure*

Observations included an initial "pure-tone period" of 28 successive test days (from December 4, 1961, through February 21, 1962) and a succeeding "miscellaneous-sounds period" of 34 successive test days (from March 12 through May 7, 1962). The initial period was an extended replication of the pure-tone phase which had been included, as noted above, in the group operant-behavior study of the previous year, and the succeeding period was designed to provide data bearing on Woodworth's perceptual-reinforcement hypothesis.

The first eight days of the pure-tone period involved assessment of the base level of bar pressing without reinforcement (operant level) by the group of subjects. This operant-level phase was then followed by 10 days during which a 1000-cycle tone of two seconds duration was available as a consequence of bar pressing and by 10 more days during which a 250-cycle tone of two-seconds duration was presented contingent upon bar pressing. As measured 12 inches from the loudspeaker port in the bar-pressing unit, both tones were presented at an intensity of 83 decidels above .0002 dynes/cm.^{2}

The miscellaneous-sounds period of observations included six successive phases, starting with a 10-day operant-level phase. Immediately afterward, the possible reinforcing effects of the following approximately two-seconds-long sounds were assessed for the numbers of successive days indicated: white noise, 5 days; sound of breaking glass (produced by shattering a large pane of glass suspended two feet above a concrete floor), 5 days; sound of a pencil being sharpened by an office-type sharpener, 4 days; sound of the statement, "Get away from here!" vocalized in a commanding tone by an adult male voice, 5 days; and sound of a rather unmusical toy music box (one of the playthings available in the school) producing no recognizable tune, 5 days. All stimuli were presented at a peak loudness of 85 decibels above .0002 dynes/cm^2 as measured 12 inches from the loudspeaker port. At this sound level, relatively good fidelity of reproduction of the breaking-glass sound in the neighborhood of the bar-pressing unit was obtained and the other sounds used were adjusted to the same peak level.

Observations were made daily starting at 9:00 a.m., the time of final arrival of youngsters at the school (at which time the cover enclosing the bar was removed), and ending between 9:50 and 10:00 a.m., when the regular daily free-play period was terminated by the teacher in charge. At the end of each test session, the cover of the bar enclosure was replaced and locked.

The teacher and other adults present in the school adhered to instructions neither to encourage the children to react to the bar-pressing unit nor to discourage them from reacting. Finally, it should be noted that the bar-pressing unit, with the bar continually enclosed, had been present in the school room from the time of opening of the school during the first week of October, 1961.

C. Results and Discussion

The results obtained during the initial pure-tone period are shown in Figure 1. In this figure, the mean numbers of bar depressions per child present in school per day have been plotted against successive test days. The tables in each of the panels show the numbers of children present in the school on each of the test days. As in the preceding group operant-behavior studies (1, 2), the day-to-day *N*s of children present vary due to absences of individuals because of illness, weather conditions, and other reasons.

Compared with the rather regular initial high rate and declining operant-level curves obtained by Antonitis and Barnes (1), the operant-level "curve" in the left panel of Figure 1 indicates that the initial rate of bar pressing by the present group was rather low and that the rate varied irregularly from day to day. These effects could be due, perhaps in part, to the fact that the bar-pressing unit with bar inaccessible had been present in the room for two months before observations started with the result that the children had become well adapted to the gross stimulus features of the unit before the first test day. Close examination of the operant-level data, however, indicates a perceptible decline in responding over the eight days except for the unusual increase on Day 6, a Monday. It is noteworthy that similar (though smaller) postweekend increases in initial operant-level curves have been obtained in

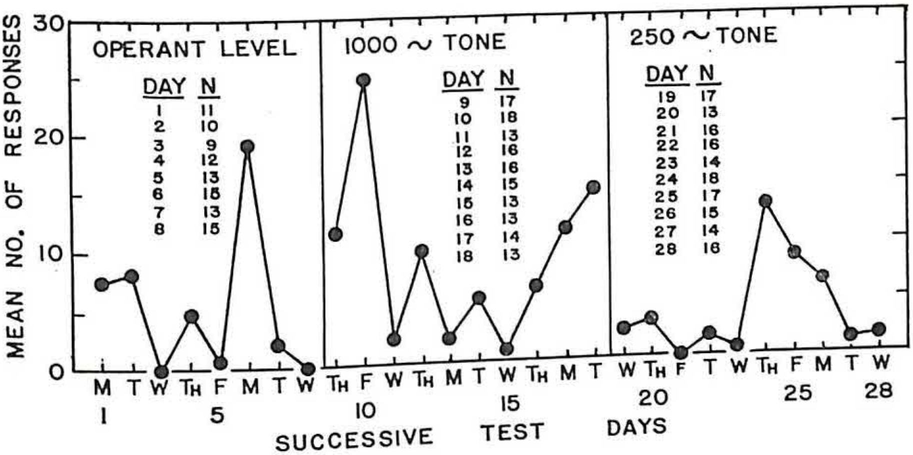

FIGURE 1
MEAN NUMBER OF RESPONSES PER DAY PER CHILD PRESENT IN SCHOOL DURING THE PURE-TONE PERIOD

The tables in the panels show the number (*N*) of children present in the school on each test day; the letters M, T, W, etc., on the horizontal axis designate the days of the week. An interval of 17 days between test sessions, due to Christmas vacation, occurred between Days 10 and 11, and a 24-day interval between test sessions was occasioned by an intersemester break between Days 21 and 22. Apparatus failure was responsible for a one-day interval between Days 12 and 13.

previous group operant-behavior studies (1, 2). Averaged over the eight operant-level days, the mean number of bar presses per child per day is 5.7.

The central panel of Figure 1 shows the results obtained when the 1000-cycle tone was introduced as a reinforcer. The initial increase in frequency of group bar pressing over the preceding operant-level frequency is clearly apparent; however, the increase occasioned by the pure tone is not large nor does the reinforcing potential of the tone hold up very well after the second day (Day 10). Over the ten 1000-cycle tone days, the mean number of responses per child per day is 9.4. Compared with the mean daily operant-level frequency of 5.7 responses, this indicates a 65 per cent response increase that may be attributed to the 1000-cycle tone.

When the mean response frequencies represented by the points plotted in the right panel of Figure 1 are compared with the operant-level data points in the left panel, the conclusion is that the 250-cycle tone had no apparent reinforcing potential. Averaged over the ten 250-cycle tone days, the mean number of bar presses per child present per day is 4.2, a daily rate somewhat lower than the daily operant-level rate.

When the present pure-tone period results are compared with the results of the pure-tone phase of the group operant study of the prior year (2), the similarity is striking. From this comparison the conclusion is that even when a 1000-cycle tone is presented as a reinforcer for bar pressing at the start of observations with a group of preschool children, its reinforcing potential is slight and transitory, and an immediately succeeding 250-cycle tone has no apparent reinforcing value.

While it might be argued that the 250-cycle tone would have manifested some reinforcing potential had it been introduced before the 1000-cycle tone rather than afterwards, the following alternative explanation of the differential effects of the two tones is offered as a more likely one. During the pure-tone phases of the work [both with the present group and with the group of the preceding year (2)], the youngsters, when in the neighborhood of the unit, were heard to refer to the 1000-cycle tone as a "whistle"; but they did not in any overt verbalizations similarly "identify" the 250-cycle tone. To the experimenter and other adults, the 250-cycle tone resembled the sound of a foghorn or of a steamboat whistle. The suggestion is that the youngsters lacked experience with foghorn and steamboat-whistle sounds and, for this reason, could not make a satisfactory perceptual identification of the lower tone; but, because of prior experience with human whistling sounds, could identify the higher tone. In accord with Woodworth's perceptual-reinforcement hypothesis (3), the suggestion is that generalized identification of the higher tone by some subjects mediated at least some part of its slight reinforcing potential, and that such reinforcement mediated by perception did not occur in the instance of the lower tone.

The results obtained during the miscellaneous-sounds period are shown in Figure 2. The extreme left operant-level data panel indicates an extremely low mean daily response frequency, the mean number of bar presses per child present per day over the 10-day period being 1.9. During the next five-day white-noise phase, the mean number of responses per day rose to 3.9 per child, averaged over the five days. From these data the conclusion is that the two-second white-noise stimulus had little or no apparent reinforcing potential. During the white-noise phase, the children did not indicate in their spontaneous verbalizations that they identified the sound. The teacher in charge, who was making observations, reported that the youngsters were "simply not impressed" by the sound.

When the breaking-glass sound was made available on Day 16, however, there was an immediate increase in group bar pressing to an average of 38.1 responses per child on that day (see Figure 2). The decrease on Day 17 to almost zero is explained by the fact that on that day, during the free-play

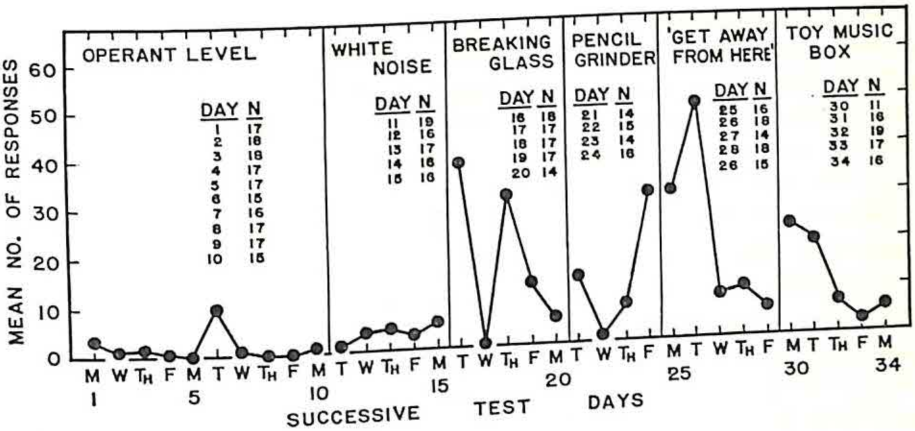

FIGURE 2

Results Obtained during the "Miscellaneous-Sounds" Period

A one-day interval between Days 1 and 2 was occasioned by closing of the school due to heavy snow; a nine-day interval occurred between Days 14 and 15 because of spring vacation; and a one-day interval between Days 31 and 32 was due to a one-day May-vacation break.

period, the activity of coloring Easter eggs was made available for the first time in the school, and practically all youngsters chose to engage in this activity in preference to usual, more active and varied free play during the first school hour. On the following day, Day 18, when no novel activity was provided during the first hour, the mean number of responses per child rose to 30.9, well above the operant-level and white-noise phase mean daily response levels. Averaged over the five breaking-glass-sound days, the mean number of responses per child present per day was 20.6. Observations during this phase indicated that the breaking-glass sound was clearly identified by the youngsters. On the first day of this phase, a boy who pressed the bar shortly after removal of the bar cover procured the sound and shouted so that all children could hear, "It's broken!" and pressed again. All but two or three of the youngsters in the room gathered around the unit, vied with each other for turns at the bar, laughed, and shouted frequently, "It's broken! It's broken!"

During the next four days, when the amplified sound of a pencil being sharpened was introduced, the mean response frequency on the first day of this new sound (Day 21) rose above the level on the last preceding breaking-glass-sound day, then dropped almost to zero on the next day (see Figure 2). It was apparent to the experimenter, who was making observations, that neither the youngsters nor the adults present in the school could identify the sound; however, on the third day of this phase (Day 23), the significance of a "motor" was attached to the sound by one boy and communicated by him to other youngsters who happened near the unit. This could well account for the rise in bar pressing to a mean of 30.3 responses per child on Day 24, the last day when the "pencil-grinder" sound was available. From this observation, the suggestion is that the process of attributing "meaning" to the sound, as in the instance of the 1000-cycle tone, resulted in the sound gaining in reinforcing potential. During the pencil-sharpener-sound phase, the daily mean number of responses per child was 13.4.

From Day 25 to Day 29, the negative vocal statement, "Get away from here!" was made available. As soon as the discovery of this new sound was made by one child (several minutes after the bar cover was removed), the now "talking box" immediately attracted the majority of the children. They took turns pressing and often shouted in reply, "Get away from here!" or "Get away from here yourself!" As in the earlier study by Antonitis, *et al.* (2), the present negative vocal statement had immediate clear and high-positive reinforcing potential (see Figure 2), but this reinforcing potential declined with successive days. The mean number of responses per child per day over the five days of this phase was 24.7, the highest rate induced by any of the sounds used as reinforcers with the present group. The behavior of the children indicated that there was no doubt that all present clearly identified the object character of the stimulus.

Finally, the extreme right panel of Figure 2 shows that introduction of the sound of a toy music box, occasionally played with by the children in the school, resulted in a marked increase in responding on Day 30 over the level that prevailed on the last vocal-statement day (Day 29). The mean daily response rate then declined regularly on succeeding days. Averaged over the five days of this final phase, the mean number of responses per child per day was 10.2.

The data obtained both during the pure-tone and miscellaneous-sounds periods may be interpreted as providing tentative confirmation of the validity of Woodworth's hypothesis that identification of the object character of a stimulus serves to reinforce the perception of that stimulus (3). In the present study, the sounds that were identifiable by the children served, at least upon initial introduction, as stronger reinforcers of bar pressing than sounds that were apparently not identifiable. Thus, for preschool children, the degree to which a non-noxious auditory stimulus will reinforce operant behavior appears to be dependent in part on the identifiability of the object character of the stimulus. The stimulus characteristic of identifiability is, of course, the product of prior experience with a particular stimulus or with stimuli of similar characteristics.

D. SUMMARY

The reinforcing effects of pure tones of 1000 and 250 cps, and of several sounds with and without apparent identifiable object character, on the bar pressing of a group of children in the real-life environment of a nursery school were studied. Observations were made daily during the initial free-play hour of the school over a period of several months during one academic year. The results indicate that the reinforcing potential of the 1000-cycle tone was weak and transitory and that the 250-cycle tone was apparently not reinforcing. Continued observations of the reinforcing effects of the other sounds provided results consistent with the hypothesis that the reinforcing potentials of non-noxious sounds are in part dependent on the factor of "identifiability."

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CHILDHOOD MEMORIES OF SINGLE AND RECURRENT INCIDENTS*

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A. INTRODUCTION

A review of the investigations concerned with childhood memories by Dudycha and Dudycha (2) showed that various questions have been posed by different authors: age of first memory, sex differences, sensory modality of memories, relation of memory to intelligence and to the various emotions. The relative frequency of pleasant to unpleasant memories has been popular because of its assumed relevance to Freudian theory. See Rappaport (5).

The present study was motivated by the current interest in single-trial learning. A search of the literature revealed no previous study concerned primarily with a comparison of early memories for single and recurrent incidents. Following Dudycha and Dudycha's recommendation (2), only memories for the first five years of life were used. Colgrove (1), using mailed questionnaires, found that males remember more repeated occurrences and that females remember more novel occurrences from the first five years. Potwin (4), using only the first memory of each *S*, confirmed this finding for females. Of Smith's nine *S*s (6), 57 per cent of the 101 memories for the first years were for novel events and 15 per cent were for repeated events. The rest were presumably classified as unexpected, which would appear to be largely single occurrences also. However, because of the problems of collection of data, the purposes of investigation, and the systems of classification, it is difficult to evaluate these results in relation to single and recurrent incidents.

B. METHOD

1. *Subjects*

The *S*s used in Sample I were 18 female and 17 male college students; in Sample II, the year following, 20 female and 20 male college students. In both samples, the *S*s were in their late teens or early twenties.

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2. *Procedure*

Each *S* was interviewed alone by one of the *E*s, a different *E* for each sample, and was asked to recall as many experiences as he could that occurred between the ages of 1 through 5 years. There was no time limit on the interview. Each *S* was cautioned to give only those experiences that he remembered, not those he was told by someone else. The *E*s asked each *S* his age at the time of the experience and whether the memory was of a single event or of a recurrent one and recorded the recalls. Each *S* was instructed that if an experience occurred more than once, even though it could be remembered for only one occasion, it was to be classified as a recurrent incident. Each *S* was also asked if the experience was pleasant or unpleasant at the time of its occurrence. To help date the memory, each *S* was encouraged to report only memories of events that occurred before he entered school.

C. RESULTS

The relative frequencies of childhood memories based upon single incidents (SI) and recurrent incidents (RI) are presented in Table 1. For the males in both samples, there is a significant difference in favor of recall of SIs. For the females, there are no significant differences in either sample, but the total trend for the females favors SIs; thus the difference for the total *N* is significantly in favor of the SIs. It should also be noted that the variability for females is consistently greater than for males. Table 1 was derived by giving each *S* two scores, one for SIs and one for RIs. The standard error was based upon the distribution of the differences between these two scores.

TABLE 1
RECALL BASED UPON SINGLE AND RECURRENT INCIDENTS

Sex	*N*	M_{SI}	M_{RI}	SE_D	*t*
		Sample I			
Female	18	2.06	2.16	2.90	.14
Male	17	3.12	1.47	1.94	3.40**
		Sample II			
Female	20	5.30	4.55	3.63	.90
Male	20	3.50	1.95	2.87	2.35*
		Samples I and II Combined			
Female	38	3.76	3.42	3.33	.62
Male	37	3.32	1.73	2.50	3.81***
Both sexes	75	3.55	2.59	3.01	2.73**

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Of the 460 memories collected from the 75 *S*s, 273 were from 38 females ($M = 9.18$) and 187 were from 37 males ($M = 5.05$). The difference between the mean recall of males and females is highly significant ($p < .001$). Of the female memories, 52 per cent are of SIs; of the male memories, 66 per cent are of SIs.

Table 2 presents the analysis of the reported emotional tone of the incident at the time of its original occurrence in terms of pleasantness (P) and unpleasantness (U). The first section of Table 2 shows that there is a significant difference in favor of P for both males and females and, consequently, for all *S*s. However, the chief interest is in the separate analyses of SI and RI in terms of P and U. The method of analysis was the same as for Table 1; i.e., each *S* was given two scores, a P and a U score for both his SIs and RIs. The *N* for the three sections of the table are not identical since 15 *S*s recalled only SIs and 3 *S*s recalled only RIs.

TABLE 2

PLEASANTNESS AND UNPLEASANTNESS FOR SAMPLES I AND II COMBINED

Sex	N	M_P	M_U	SE_D	t
		Overall P and U			
Female	38	4.24	2.95	3.29	2.38*
Male	37	2.97	2.02	1.97	2.89**
Both sexes	75	3.61	2.49	2.72	3.54***
		Single Incidents			
Female	35	1.63	2.43	2.08	2.25*
Male	37	1.68	1.65	1.57	.10
Both sexes	72	1.65	2.03	1.50	2.15*
		Repeated Incidents			
Female	31	3.35	.87	2.64	5.13***
Male	29	1.72	.48	1.43	4.56***
Both sexes	60	2.57	.68	2.23	6.44***

* $p < .05$.
** $p < .01$.
*** $p < .001$.

It is interesting to note that the results for the SIs, on the whole, are opposite to those for overall pleasantness and unpleasantness. There is no great preponderance of U over P for the SIs; there is no difference of any consequence for the males, but there is a significant difference in favor of U for the females and for all *S*s. The females in both samples had a preponderance of U recalls. The males for Sample I agreed with the females, but the males of Sample II showed about an equal difference in favor of P; thus the differences in the two samples for the males cancelled each other.

The preponderance of pleasantness for the RIs (see the third section of Table 2) is highly significant for both males and females, thus accounting for the overall significance of the difference in favor of pleasantness.

Since a difference in pleasantness and unpleasantness of SIs and RIs had not been reported previously, the data were further analyzed. The above analysis does not make a direct comparison of P and U for SIs and RIs. Also the question might be raised as to whether or not the data meet the assumptions of a parametric method. Consequently, a chi-square analysis was made. For this analysis, only the 57 *S*s who had recalled both SIs and RIs were used. Each *S* was assigned twice to P or U, once on the basis of the majority of his P or U recalls of SIs and once (on the same basis) for his RI recalls (3, p. 225). This analysis confirms the finding reported above that the memory of a SI was more likely to be U ($p < .02$). The 18 *S*s not included in the above analysis followed a similar pattern: of the 15 *S*s who had recalled only SIs, 11 had a majority of U, three of P, and one tie; of the three *S*s who had only recall of RIs, all had a majority of P.

D. Discussion

In the three published reports of childhood memories in which the point is raised, there is agreement that SIs are remembered more frequently than are RIs. Although these earlier studies were not designed to test this particular variable, and statements of significance of differences were not made, the results are in agreement with the findings of the present report. Both Colgrove (1) and Potwin (4) reported that females recall a higher per cent of SIs than do males, the opposite of the present results; consequently, the reality of a sex difference in this respect is questionable.

That there are more SIs than RIs remembered by late adolescents from the first five years of life is of some comfort to the advocates of single-trial learning, since at least some things are learned well and with relative permanence in one trial. It is also a paradox to be explained by the frequency theorists. For instance, one male remembered clearly the visit of Santa Claus at 4:7 years (the date was well fixed because the family moved the next summer) and how he was scared but tried to hide his fear from the family by playing a game of train with a block, which allowed him to seek security under a drop-leaf table at the opposite side of the room from Santa. For obvious reasons, this attitude was not reported to the family, yet it is much more clearly remembered than the cry of the paper boy who used to come down the street shouting "Daily Sentinel," a routine which the *S* used to imitate with a paper under his arm as he walked around the property (an incident verified by the mother). It is of little comfort to the frequency theorists to try to explain the memory of the SI by postulating subsequent review since it would have to be learned in order to be reviewed. Also, RIs and SIs would have equal opportunity for subsequent review.

The finding in the present study that adolescents report more P than U incidents from early childhood appears to be well established since the difference between the means is significant for both males and females and for both samples. This finding is in line with the preponderance of evidence reported in the literature (2). The indication in the present study that there is a predominance of U memories for SIs and a much greater preponderance of P memories for RIs has not been previously reported. Apparently, the difference in probability of pleasantness for memories based upon SIs and RIs has been hidden by lumping them together in previous studies, as illustrated in the first section of Table 2.

E. SUMMARY

The recall of 460 childhood memories (1 to 5 years) by 75 adolescent *S*s, in two samples one year apart, collected by four *E*s, were analyzed on the basis of relative frequency of single and recurrent incidents, and on the basis of emotional tone of the incident at the time of its occurrence. More SIs than RIs were recalled ($p < .01$). The SIs were more likely to be unpleasant ($p < .01$) and the repeated incidents more likely to be pleasant ($p < .001$). Because of the large preponderance of pleasantness for the repeated incidents, the total recalls were more likely to be pleasant. The difference in pleasantness for single and repeated incidents has not been previously reported. The preponderance of recall of SIs poses a paradox for a frequency theory of learning.

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THE RELATION BETWEEN CURIOSITY AND SECURITY IN PRESCHOOL CHILDREN*

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A. INTRODUCTION

Over the past several years, psychologists have shown an increasing interest in the study of curiosity. While most of the research on this topic has taken place within the realm of animal psychology (largely in terms of exploratory behavior), some research has employed adult humans as subjects and, more recently, a few studies of curiosity in children have been published. Several points of view have given impetus to the research interest in curiosity at the childhood level. First, curiosity and creativity have been considered to be related (4); and the latter is a widely researched topic currently. Second, several studies have shown a relation between curiosity and reading ability and reading comprehension (6, 7). Third, it seems especially possible at the childhood level to discover conditions antecedent to differences in the level of curiosity manifested.

While attempts have been made to derive explanations of curiosity motivation from several theoretical positions, the rationale for the present study stems from Harlow's finding (2) that the amount of investigative, exploratory behavior exhibited by infant monkeys is related to the presence or absence of the surrogate mother. Further, McReynolds (8) found some evidence for a negative relation between anxiety and curiosity in a group of psychiatric patients. In a later study, McReynolds, Acker, and Pietila (9) reported a significant negative correlation between a measure of curiosity and teacher's rating of psychological maladjustment in a group of sixth-grade children.

Although admittedly the terms security and insecurity have not been precisely defined, the notions that they describe seem psychologically more relevant than does the concept maladjustment to an understanding of manifest curiosity in children. Moreover, a considerable amount of research has been devoted to the task of assessing security in children. A factor analysis of checklist descriptions of social behavior and personality attributes of 4-year-olds yielded a factor which Stott (12) labeled, "insecurity *vs.* relaxed spontaneity."

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Several researchers (3, 11) have linked children's reaction and adjustment to a strange situation to family-antecedent variables. In support of interpreting the behavior of Harlow's infant monkeys in the "open-field" situation in the absence of a mother surrogate as suggesting insecurity, Arsenian (1) found that children entering a strange room accompanied by their mothers were rated higher in security than children who entered the room alone.

The major purpose of the present study was to test the hypothesis that curiosity is positively and significantly related to security in preschool children. In addition, several measures of curiosity were explored and their relation to teachers' ratings of curiosity were examined.

B. METHOD

1. *Subjects*

Twenty-five children, 13 girls and 12 boys, served as subjects. They comprised the entire 4-year-old group of a parent-participating nursery school. The mean age of the group was 4:7 years.

2. *Instruments*

The materials used for testing curiosity were similar to those used by McReynolds, Acker, and Pietila (9). Twelve relatively common toys and household objects were used as stimuli to elicit curiosity. Toys were chosen that would be interesting to 4-year-olds and that would allow for varying amounts of manipulation and exploration. The objects used were a magnet; a toy motorcycle; an harmonica; a rubber ball; a toy car (taxi); a whistle in the shape of a spaceship; a small rubber doll with movable arms, legs, and head; a plastic fork; a ballpoint pen; a pair of pliers; a corncob pipe; and a wooden clothespin. The curtained box from which *S* drew the toys measured approximately 18″ by 14″ by 6″. *E* scored *S*'s manipulations on a mimeographed score sheet on which were listed all possible manipulations for each toy. A stopwatch was used to measure the time that *S* spent with each toy.

An estimate of *S*'s security was obtained by having the director of the nursery school and her assistant rate independently the children on the six behavioral-rating scales developed by Prichard and Ojemann (10). The rating scales were identified to the teacher as "ratings of some child behavior." The two teachers also rated the children on two global scales, insecurity and curiosity, so that eight ratings were obtained. A description of the insecure child taken from a factor analysis reported by Stott (12) was used to define the insecurity scale, and the definition of curiosity proposed by Maw and Maw (7) was used as the basis for the curiosity scale.

3. *Procedure*

The experimenter was introduced to each child by one of the teachers. Saying that he wanted to show *S* some toys and to play some games with him, the experimenter escorted *S* to the room where the experiment was conducted.

The experimental procedure consisted of three parts. Curiosity Test I was the manipulation task (equivalent to the identification task of McReynolds *et al.*) and yielded two scores—manipulation and time. When the experimenter and *S* arrived in the room, *E* said:

> I am going to show you some toys in a minute. It won't take very long and you can get back to the nursery school pretty soon. We are going to play a kind of guessing game. You are going to sit in front of this box. I am going to put a toy inside the box. When I tell you to, I want you to stick your hand through the curtains, touch the toy, and try to guess what it is. After you've had a chance to guess what it is, you may take it out of the box. Then you may look at the toy for awhile and play with it if you want to. When you are through playing with it, just put it here on the table and I will give you another toy to guess.

Then *E* placed the first toy inside the box.

> All right, you can put your hand in now and pick up the first toy.

When *S* guessed what it was, or after about 10 seconds had passed, *E* said:

> Okay, go ahead and take it out. Put the toy here on the table when you are ready to guess the next one.

E then placed the toys, one at a time, in the box which opened toward him, but which had curtains across the side facing *S*.

During the "play" period, *E* recorded the number and type of manipulations by simply checking the manipulations listed under each toy on the score sheet. The length of the play period was also timed and recorded. In scoring, one point was allowed for each manipulation of an investigatory nature, with repetitions counting the same as original manipulations. One point was also scored for each meaningful question about an object and for each spontaneous comment that implied curiosity. The manipulation score for each child was the total number of points for all objects. The time score was the total time, in seconds, spent on all 12 objects.

Curiosity Test II (curiosity of the unknown) was devised to assess a different aspect of curiosity. Eight of the objects were chosen as being most "toy-like." They were arranged in a randomly determined order and placed on the table in the view of *S*, one at a time. *E* then pretended to place another toy behind the box where *S* could not see it. *S*'s task was to decide whether he would rather play with the known toy or with the unknown one. *E* directed each child as follows:

> Now we are going to play a "pretend" game. I am going to put one of the toys you have played with here (on the table in front of *S*). I am going to put another toy behind the box. I want you to pretend that you could play with either toy for as long as you want. I want you to choose between the two toys. Tell me if you want the toy you can see or the one you can't see. Okay, here is the first one. Do you want this toy (*E* points to toy on table) or the one inside the box that you can't see?

On alternate toys, the question was asked in reverse form. *S*'s score on Curiosity Test II was the number of "unknown" toys chosen.

Curiosity Test III (curiosity in a choice situation) was aimed at measuring a third aspect of curiosity. The test consisted of reading to *S* nine two-choice situations in which the problem essentially was whether to explore or not to explore. The following is an example:

> A little boy (girl) is walking beside a yard that has a big high fence around it. There is a hole in the fence. Then the boy (girl) hears a noise coming from inside the yard. Does he (she) keep on walking or does he (she) stop and look through the hole?

Each situation was described in the third person, and the child in the situation was always the same sex as *S*. The curiosity score for Test III was the number of stories for which *S* selected the "approach" or "exploration" choice in preference to the choice that indicated an avoidance of the situation.

After all three segments of the session were completed, *E* thanked the child for coming in and playing with him, and then escorted *S* back to the nursery school. The total elapsed time for each child varied from 15 to 30 minutes.

C. RESULTS

For comparison with the measures of curiosity, the ratings of the two teachers were pooled by taking the arithmetic mean of their ratings for each child on each scale. Pearson product-moment correlations between the two ratings on the eight scales and on the combined rating yielded correlation coefficients that ranged from .16 to .74. Six of the nine *r*s were significant beyond the .05 level of confidence. The overall interrater reliability was .69. The two nonsignificant coefficients occurred on the scales "voluntary withdrawal" and "apprehensiveness." Interestingly, the two teachers showed the highest agreement in rating the children on the global scale "insecurity."

The mean manipulation score for the 25 *S*s on Curiosity Test I was 35.3, with a range from 10 to 75. Split-half reliabilities of the curiosity measures were determined by randomly assigning the toys to two groups. A rank-difference correlation between S's scores on the two groups of toys was computed and the Spearman-Brown correction was applied. The split-half reliability of the manipulation scores was .86. The time scores of Curiosity Test I ranged from 92 to 2,160 seconds, with a mean of 415.7 seconds. The split-half reliability, corrected for half-length, was .94. The mean score on Curiosity Test II (curiosity of the unknown) was 3.9, with a range from zero to six. Curiosity Test III (curiosity in a choice situation) had a mean of 4.8 and a range from zero to nine.

Intercorrelations between S's scores on the four curiosity measures were calculated to determine the relations between the different measures. These correlations are given in Table 1. There was a significant correlation of .64 ($p < .01$) between time scores and manipulation scores, but the other five coefficients were not significant.

TABLE 1
INTERRELATIONS AMONG CURIOSITY MEASURES

	Curiosity measures		
Curiosity measures	Test I Time score	Test II	Test III
Test I			
Manipulation	.64*	.09	—.14
Time score		.05	—.05
Test II			—.11

* $p < .01$.

To determine whether or not there were sex differences in curiosity scores, t tests for uncorrelated data were calculated for each curiosity measure. The boys obtained slightly higher scores on manipulation and time, and the girls received higher scores on Curiosity Tests II and III. However, none of the t ratios was significant. Thus no sex differences in curiosity were obtained.

TABLE 2
CORRELATIONS BETWEEN POOLED TEACHERS' RATINGS AND CURIOSITY TEST SCORES

	Curiosity measures			
Rating scales	Test I Manipulation score	Time score	Test II	Test III
1. Voluntary withdrawal	.22	.07	.26	.24
2. Nonacceptance	.21	.01	.21	.06
3. Bidding for attention	—.18	—.11	.07	.05
4. Crying	.15	.02	—.14	—.12
5. Hyperactivity	.03	—.25	—.13	.05
6. Apprehensiveness	—.01	—.06	.00	.05
Scales 1 to 6 combined	.03	—.05	.06	.08
7. Security	.15	.08	.15	.03
8. Curiosity	.13	.02	.00	.03

In testing the hypothesis of a positive correlation between curiosity and security, Pearson product-moment correlations were calculated between the pooled teachers' ratings on each of the eight scales (plus a combination of Scales 1 through 6) and the four curiosity scores. Twenty-seven of the 36 correlation coefficients listed in Table 2 were in the predicted direction. However, none of the coefficients reached the .05 level of significance.

D. Discussion

One of the purposes of this study was to explore several measures of curiosity. The results indicated that the first two measures, number of manipulations and time spent exploring the objects, were highly reliable. McReynolds, Acker, and Pietila (9) reported a split-half reliability of .87 for their total-object curiosity scores. These scores included observations of free play as well as the manipulation scores that were used in the present study. The split-half reliability of their identification task, which was essentially the same task as Curiosity Test I, was reported to be .75. For the manipulation scores, the split-half reliability of .86 obtained in the present study compares favorably with previous results. From the present study, there is some indication that the amount of time spent in manipulating the objects might be a more reliable measure of curiosity than the number of manipulations.

From Table 1, it is apparent that there is little relation among the four measures of curiosity except for the significant correlation between the manipulation and time scores of Curiosity Test I. This finding suggests that curiosity is not a unitary characteristic and that future research must be concerned with identifying various aspects of curiosity rather than attempting to relate a single measure of curiosity to other variables.

The coefficients listed in Table 2 provide no support for the hypothesis of a positive relation between security and curiosity. And, indeed, no relation was found between the various curiosity measures and the teachers' ratings of curiosity. It must be pointed out that interrater reliability figures are higher for the insecurity and curiosity scales than for any of the other ratings scales—.74 and .62, respectively. The inescapable conclusion is that the curiosity measures employed in the present study do not measure the kind of curiosity defined by Maw and Maw, and which was used as the basis for the teachers' ratings. Again, it would seem that an important task for future research is to develop valid laboratory measures of curiosity—measures that correlate satisfactorily with outside criteria.

With regard to the rating scale of security employed in the present study, Martin (5) has presented evidence of "considerable agreement" between security ratings based on the Prichard and Ojemann scales and teachers' nominations of most- and least-secure children. In addition Stott's description of security (12), derived from his factor-analytic study, was used to define the global-rating scale of security (Scale 7). With this evidence, it would seem that the failure to support the hypothesis of the present study rests with the measures of curiosity rather than with the measures of security.

The present findings do not confirm those reported by McReynolds *et al.* (9) who obtained statistically significant correlations of .45 and .37 between object-curiosity scores and the teacher's rating of psychological adjustment and curiosity, respectively. Several differences in the two studies may have accounted for the contradictory findings. Four-year-olds served as *S*s in the present study, while the McReynolds' study used sixth graders. Further, the latter study examined the relation between psychological adjustment and curiosity rather than between curiosity and the more specific notion of security. Several advantages of the present study over the McReynolds study can be listed. First, interrater reliability figures were available; and, second, three measures of curiosity were used in an attempt to tap several aspects of this concept.

E. SUMMARY

Twenty-five 4-year-olds served as *S*s in a study designed to test the hypothesis of a positive relation between security and curiosity in preschool children. Security was assessed through teachers' ratings, and four measures of curiosity were employed. The results did not support the hypothesis, nor did they confirm the findings of a previous study in this area. Several suggestions for further research were made, centering around the need for identifying various aspects of curiosity and for validating the curiosity measures used.

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LIFE HISTORY ANTECEDENTS OF MEASURED PERSONALITY VARIABLES*[1]

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A. INTRODUCTION

The purpose of this study was to investigate the relationship between past experiences and present personality. The existence of such a relationship is assumed by personality theorists and psychotherapists, although hypotheses regarding the specific antecedents of particular personality variables are apt to differ. Therefore, the primary purpose was to clarify relationships existing between particular personality characteristics and specified life experiences. A second purpose was to investigate the usefulness of a life-history questionnaire in the study of personality.

The concept of personality adopted in this study was H. A. Murray's needs system (2, 3, 4) defined, operationally, as scores on the Edwards Personal Preference Schedule (1) which purports to measure 15 of Murray's manifest needs.

B. METHOD

1. *Subjects*

The subjects of this study were male volunteers registered in psychology courses at Iowa State University during the summer and fall of 1959. About two-thirds of these students were registered in an introductory course; the rest, in more advanced courses. The volunteers were motivated by two additional points of credit in their course and by the promise of some general interpretation of scores obtained on the personality test. A total of 161 complete and satisfactory sets of data were obtained. Another 10 or so sets were discarded because of low consistency scores or for other reasons.

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* Received in the Editorial Office on January 9, 1964. Copyright, 1965, by The Journal Press.

[1] Data from a thesis presented by June Loveless Hearn to the faculty of the Graduate College of Iowa State University in partial fulfillment of requirements for the degree of Master of Science, 1962.

2. *Instruments*

The Edwards Personal Preference Schedule (1) was used to evaluate personality: i.e., to measure 15 of Murray's "manifest needs."

The biographical inventory, or life-history form, is an efficient method for gathering substantial quantities of data about the past experience of an individual. For this study, the authors constructed a biographical inventory composed of items related to past experiences involving family relationships, socioeconomic status, religious training, and educational and social experiences. Items were culled from inventories used successfully in early studies at Iowa State University, and others were written specifically for this study. In general, the items chosen from all sources were directed to experiences common among college students and which they should be able to recall. The possible response choices ranged from two (e.g., "yes," or "no") to a maximum of five. Only one response choice was to be selected for any one item stem, and responses were marked by the subjects on IBM answer sheets.

3. *Statistical Treatment of Data*

Item responses (i.e., the response options for each item stem) were coded zero and one on IBM cards. Responses chosen by fewer than 10 per cent of the respondents, or by more than 90 per cent, were discarded. The remaining item responses (totaling 258) were coded on IBM cards, along with the corresponding EPPS scores for the 15 need variables. Product-moment correlations between these responses and needs scores were computed on the IBM 650.

Continuous items from the biographical inventory (i.e., items such as size of high school, number of social organizations, etc.) which, on inspection of the dichotomous correlations, indicated a continuous relationship with an EPPS variable were treated in the following manner: the dichotomous correlation coefficients from the two extremes were squared, added together, and the square root was extracted. This figure is reported as an estimate of the correlation coefficient between the continuous item and the EPPS variable. The same levels of significance hold for these items as for the dichotomous items.

Levels of statistical significance for all correlation coefficients were estimated using the formula:

$$\sigma_r = \frac{1}{\sqrt{N-2}}.$$

At the .05 level of significance, when $N = 161$, a correlation must be ± .155 or greater to be significant; at the .01 level of significance, the correlation coefficient must be ± .201 or greater. These levels of significance were selected arbitrarily, and it must be expected that some items will reach significance by chance. In this study, of 3,885 correlation coefficients computed, 381 were statistically significant, 254 at the five per cent level of confidence, 127 beyond the one per cent level.

C. Results and Discussion

Biographical-inventory responses that were statistically significant beyond the .01 level in their correlation with the EPPS scales are listed in Table 1. When an item was significant in both its positive and negative forms (e.g., $r = +.25$: father not successful, and $r = -.24$: father successful) only the positive item is reported. For the same reason, items significant at no more than the .05 level are omitted. A record of items and correlations will be filed with the American Documentation Institute.[2] This record, Table A, available from ADI, includes all items significant at the .05 level and a few approaching significance. Scales will be discussed separately below.

1. *Need for Achievement*

This (and the succeeding scales) is defined by Edwards (1) in his manual. Achievement is a need to do one's best and to accomplish difficult tasks. The significant items suggest a personal history including a mother with more-than-average education, a father perceived as unsuccessful, above-average high-school achievement, and no continuing ties with the friends of adolescence. The largest positive correlation ($r = .25$) is for the item identifying the father as unsuccessful. Whether this suggests that a person with high-achievement needs simply sees others as less successful than they should be, or whether this perceived lack of parental success acts as a "press" that stimulates the son toward achievement is not apparent from the evidence.

2. *Need for Deference*

This need is defined by Edwards as a willingness to take suggestions from others and to do what is expected. There is no assumption made regarding the underlying emotional basis for what may be a rather superficial agreeableness. The general impression gained from the significant items is an absence of interaction with others rather than any very positive experiences or characteristics: reading books, not dating, not organizing groups, socially inactive fathers.

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[2] An eleven-page table giving all correlations for each need group has been deposited with the American Documentation Institute. Order Document No. 8515, remitting $1.75 for 35 mm microfilm or $2.50 for 6-by-8-inch photocopies.

TABLE 1
SIGNIFICANT* CORRELATIONS BETWEEN BIOGRAPHICAL-INVENTORY RESPONSES AND EPPS VARIABLES

r	Item response
	1. *Need for Achievement*
+.25	father unsuccessful
+.24	never hospitalized before age 12
+.21	mother had some college
+.21	not close to high-school friends
+.20	above-average high-school student
	2. *Need for Deference*
+.25	read 12 or more books last year
—.20	occasional disagreement with parents
—.23	parents' financial status
—.24	father held important organization offices
—.25	one or two pets in home
—.30	dates in high school
	3. *Need for Orderliness*
+.24	ill less than average before age 12
+.24	father had one social organization
+.22	married
+.21	below-average financial status
+.21	no encyclopedia in home
—.22	disagreed with parents occasionally
	4. *Need for Exhibition*
+.28	superior achievement of parents
+.23	above-average high-school student
+.21	number of mother's social organizations
+.21	number of father's social organizations
+.21	seldom punished
—.20	enjoyed caring for pets
—.20	parents never praised son before others
—.21	one of those choosing others for games
—.26	first considered college after high school
	5. *Need for Autonomy*
+.32	not restricted evenings
+.28	not close to high-school friends
+.23	parents rarely or never attended church
+.22	held 1 or 2 elective offices in high school
+.20	father had some college
—.20	number of mother's social organizations
—.20	picked on by siblings
—.23	began dating between 14 and 16
	6. *Need for Affiliation*
+.34	still close to high-school friends
+.26	parents always interested in classwork
+.25	apt to be teacher's pet
+.25	over 16 when first earned own money
+.25	seldom had childhood fights
+.25	punished as a child with verbal reprimands
+.22	began dating between 14 and 16
+.22	under 21 years old
+.21	mother's social organizations
+.20	single

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* All items significant beyond the .01 level.

TABLE 1 (*continued*)

r	Item response
	7. *Need for Intraception*
+.25	would treat own child differently
+.23	mother had no social organizations
+.21	father unsuccessful
+.21	parents rarely or never attended church
+.20	size of high school
+.20	father had grade-school or less education
+.20	first considered college after high school
—.20	money partly from allowance, partly from own earnings
—.21	preferred that others care for pets
—.22	parents interested and helpful in career
—.23	under 21 years old
	8. *Need for Succorance*
+.27	still close to high-school friends
+.26	parents' financial status
+.26	number of mother's social organizations
+.24	single
+.24	still uncertain of vocation
+.22	frequency of parents' church attendance
+.22	money partly from allowance, partly own earnings
+.20	first chose own clothes in high school
+.20	quarreled with siblings occasionally
	9. *Need for Dominance*
+.31	leadership of "gangs"
+.31	helped to organize the group
+.25	amount of dates in high school
+.23	mother not fearful
+.21	always planned to attend college
+.21	dates twice a week in high school
—.23	not noticed much in elementary school
—.23	father liked to keep at job until finished
	10. *Need for Abasement*
+.22	four or more siblings
+.20	under 21 years
+.20	family never moved
+.20	father had no social organizations
+.20	father did not belong to organizations
+.20	mother fearful
—.20	above-average high-school student
—.20	size of high school
—.21	father's occupational level
	11. *Need for Nurturance*
+.20	still close to high-school friends
+.20	punished by verbal reprimand as child
—.22	parents seldom entertained
—.25	first earned own money at 12 to 16 years
	12. *Need for Change*
+.25	father's occupational level
+.21	seldom punished

TABLE 1 (*continued*)

r	Item response
	13. *Need for Endurance*
+.26	mother had no social organizations
+.22	father unskilled or semiskilled
+.20	first considered college after high school
+.20	no encyclopedia in the home
+.20	daydreams of scientific achievement
—.20	quarreled with siblings occasionally
—.21	mother had 2 to 4 social organizations
—.21	amount of father's education
—.23	parents' financial status
—.25	number of father's social organizations
	14. *Need for Heterosexuality*
+.31	Protestant
+.24	others cared for pets
+.23	daydreams of opposite sex
+.21	disagreed with parents occasionally
+.21	gathered socially at a friend's home
+.20	hospitalized once or twice before age 12
+.20	number of father's social organizations
—.20	father had no social organizations
—.20	did not argue with parents
—.23	enjoyed caring for pets
—.24	father did not belong to organizations
—.24	leadership of "gang"
	15. *Need for Aggression*
+.30	childhood fights started by someone else
+.23	father regarded as leader
+.22	gathered socially someplace other than home
+.21	parents praised son in front of others sometimes
+.20	read 3 or 4 books in last year
—.20	have never punished anyone
—.27	seldom had childhood fights

3. *Need for Orderliness*

This need is defined as having things organized and for making advance plans. Significant items relate to married students who have come from homes in which many restrictions existed: fathers belonged to only one social organization, parents entertained seldom, there was no encyclopedia in the home, there was little tendency to *express* disagreement with parents. Perhaps this might suggest lower class.

4. *Need for Exhibition*

This need is defined as preferring to be noticed favorably by others. Students expressing this need report happy, active childhood experiences: the achievement of their parents is reported as superior to most, they were above-average high-school students, parents led active social lives, they were seldom punished, and seemed to have successful social experiences.

5. *Need for Autonomy*

The need to be independent of the opinions and restrictions of others. This need seems to arise in subjects whose parents have acted autonomously and who have permitted their sons considerable freedom. The highest correlation (+ .32) is reported between need for autonomy and the experience of having no restrictions at all in evening activities as a youngster. While they report having held high-school offices, they have not remained close to their high-school friends. Fathers had some college, parents were not church attenders, and there is a negative correlation (—.20) with number of mother's social organizations. The subjects with less need for autonomy indicate closer social relations with others. Dating began between 14 and 16 years of age and they are still quite close to their high-school friends.

6. *Need for Affiliation*

The need for affiliation is described as the need to relate to others in a friendly manner. The subjects demonstrating this need in the study report that they have both received and expressed toward others a great deal of friendly interest.

These subjects are young (under 21), single, still close to high-school friends, and have been dating since age 14, 15, or 16. Their parents were always interested in their classwork, they were apt to be "teacher's pet," they do not recall fighting very often with other children, and they did not earn their own money until after 16.

7. *Need for Intraception*

This is the preference for being analytical about the motives of himself and others. The significant items suggest a restricted home background: mother had no social organizations, father was seen as unsuccessful and had grade-school or less education, parents were not church attenders. The highest correlation (.25) indicates that subjects high on this scale recall their family experiences in such fashion that they "would treat own child differently." In some respects, the significant items of this scale resemble those of "Need for Autonomy," but the father's educational level is markedly different: "grade school or less," compared to "some college" on the autonomy scale.

8. *Need for Succorance*

This need is described as a preference for receiving helpful interest from others. The need seems to appear in young men who have grown up in a family environment which did not push the boy toward maturity: parents had high-financial status, mother was in many social organizations, the boy first chose his own clothing in high school, and his own earnings were supplemented with an allowance. He is still single, close to high-school friends, and uncertain of his vocation.

9. *Need for Dominance*

This scale indicates a willingness to assume leadership in groups and a preference for asserting one's own opinions. Behavior related to this need seems to appear relatively early in life: leadership of childhood "gangs," organizing play groups, high-school dating, and early plans for college. Mothers of this group were not seen as fearful. A negative correlation appeared for fathers who liked to keep at a job until it was finished.

10. *Need for Abasement*

This need demonstrates an attitude of blame toward one's self and feelings of inferiority in relation to others. The group for whom significant items appeared was young (under 21), came of a large and settled family, and had fathers who were not active socially and mothers who were seen as fearful. A low need for abasement reflected the opposites of the above, plus showing a negative relationship to father's occupational level, to size of high school, and perception of self as an above-average high-school student.

Whether such data confirm the relationship of early experience to present needs, or simply reflect the self-perception of subjects, is a problem inherent in the use of any kind of self-report. Certainly these items make "sense," if taken at face value.

11. *Need for Nurturance*

This need is defined as a preference for being helpful and sympathetic toward others. There were few significant items and, to the writers, they do not form any discernible pattern.

12. *Need for Change*

The significant items suggest that the need for variety of experience is related to father's educational level and a free and accepting atmosphere at home; i.e., punishment seldom occurred.

13. *Need for Endurance*

A high need for endurance is associated with what one might interpret as a lower-social, or at least a lower-economic, pattern of early life: a father in skilled or semiskilled trades, a mother with no social organizations, no consideration of college until after high school, no encyclopedias in the home. To this is added striving: daydreams of scientific achievement. Low needs in this area rather clearly reflect the opposite kind of background.

14. *Need for Heterosexuality*

Edwards defines this scale as a preference for social, emotional, and vicarious association with the opposite sex. Local experience with this scale suggests that it is more related to dating or courting behavior than to sexual needs as such; e.g., low heterosexuality needs have been found for married male students in this university and for a group of married male industrial salesmen in their 30s. There is a negative correlation between the scale and being married. Perhaps the social desirability of these items is different for married males than for single males. The highest correlation found was for Protestant religion. A correlation of —.31 was found for Catholic religion. Whether religious membership affects heterosexual needs as such, or simply the expression of them, is not possible of determination from such data. Disagreement with parents and gathering at friends' homes (rather than at one's own home) suggest something of separation from family control and supervision relatively early. Men with low needs appear to have been less active socially in general than the high group: they were not "gang" leaders, father had no social organizations, they did not argue with parents, they gathered at church or YMCA instead of at someone's home, etc.

15. *Need for Aggression*

This need is defined as a preference for argument and displaying angry behavior verbally. Aggression needs developed in a family where fathers were seen as leaders and where childhood fights occurred, but were seen as being caused by someone else. The high group reports gathering away from home for social activities. The low group reports no experience in "punishing" anyone, and seldom had fights in childhood.

D. GENERAL INTERPRETATION

The usefulness of the biographical inventory for investigations of the antecedents of personality seems amply demonstrated by the number of correlates found for each scale and by the meaningfulness of the responses. Approximately twice as many significant correlates were found as would be expected if chance alone were operating. Administering the inventory to an independently chosen sample would clarify questions of intrinsic relationships and those due to chance or sampling bias. The discussion of each scale has been an attempt to organize the data in a reasonable way, though it is recognized that these interpretations are not the only ones possible.

The biographical inventory administered to these subjects was not designed to test specific hypotheses regarding the origins of manifest needs. However, it was felt that the nature of many of the items would give general information about the importance of "deprivation states" in contrast to reinforcement leading to typical behavior of the subjects. The wording of instructions for the EPPS permit responses referring either to "what you like" or "how you feel." It is conceivable that high scores on particular variables would be consistently associated with past experiences characterized by lack of opportunity to express the need.

Murray's theory includes all possibilities. He states that frustration of needs can lead to inhibition of the need or to exaggerated striving. Recurrent needs may be repetitions of, or reaction formations to, gratification, frustration, or deprivation. Reinforcement or reward of certain behaviors would also increase the probability of the behaviors recurring.

Murray's intensive study of 50 college men, reported in *Explorations in Personality* (2), failed to produce to Murray's satisfaction generalizations relating specific needs to particular early experiences. The data from this study can be interpreted as throwing some light on these relationships. The data can also be interpreted as revealing the influence of personality variables on the perception of past experiences. When need for aggression is found to be positively related to "childhood fights usually started by someone else," what we have learned from the response is not only that these subjects were involved in childhood fights, but rather something more about how these experiences are now perceived by the subjects. Murray states that a need may markedly influence the perception and interpretation of external occurrences, and the biographical-inventory responses of this study seem to reflect the influence of personality on the perception of past experiences as well as demonstrating the influence of early experiences on present personality. (2, pp. 65, 123, 260)

Inspection of these data appears to support an interpretation of the manifest needs measured by the EPPS as being closely related to typical behavior appearing early in the life experiences of these college males. There are also indications that this behavior has been "successful," which indications would support reinforcement concepts of personality development. Need for achievement, for example, is associated with above-average high-school performance. Other needs are particularly marked by the consistency which they display throughout the life experiences. For example, subjects expressing a need for dominance were organizers and leaders of their childhood gangs. Need for affiliation is associated with early and continued friendly relations with others.

There seems to be a marked similarity between the descriptions of the parents' behavior and the needs expressed by their sons. For example, need for exhibition occurs among young men whose parents had superior achievement and who led active social lives. Need for autonomy is related to having mothers who did not belong to social organizations and to having parents who rarely or never attended church.

Throughout the study, there are many indications of the importance of socioeconomic factors in personality development. Items referring to level of parents were significantly related to many of the EPPS scales. Only one variable was affected by all three of these aspects of socioeconomic level. Need for endurance was associated with lower occupational, educational, and financial status of the parents. It may take the kind of persistent activity implied by need for endurance for men from such a background to enter college.

Some scales showed marked similarities in the life experiences associated with each. Correlates of need for affiliation and nurturance were similar. Many of the life experiences significantly related to one were also related to the other and in the same direction. This may be an indication of the degree of intercorrelation between the two scales. Need for succorance and need for intraception also shared some of the same correlates, but these were often correlated positively with one variable and negatively with the other, as though the needs were negatively related to each other. These questions of the intercorrelations of Edwards' rationally derived scales administered in a forced-choice format deserve further investigation.

E. SUMMARY

A specially constructed biographical inventory and the Edwards Personal Preference Schedule were administered to 161 college males. Correlation coefficients between item responses and each of the 15 EPPS variables were computed. The statistically significant correlates are discussed and some generalizations about the antecedents of personality are tentatively made. The following conclusions are drawn:

1. The biographical inventory was found to be a useful tool in investigating the life-experience antecedents of the EPPS personality variables.

2. The personality variables measured by the EPPS are closely related to behavior appearing early in life experiences and to behavior typical of the individual.

3. The results provide some support for a reinforcement theory of personality development.

4. The behavior and personality of the parents, and the identification of the subjects with the parents, influence personality.

5. Socioeconomic and educational level of the parents are important determiners of personality.

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THE CHANGING COMPOSITION OF "INTELLIGENCE": A REPLICATION OF A FACTOR ANALYSIS*

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A. INTRODUCTION

In 1954, Hofstaetter (4) published the results of a factor analysis of a matrix of correlations published earlier by Bayley (1). The correlation coefficients were between age-level standard scores of intelligence tests given to the same group of children between the ages of one month and 18 years. In the footnote to her Table 4, which presents the intercorrelations, Bayley explains, "These scores are the means of standard scores for three consecutive test-ages, e.g., months 1, 2, & 3; 4, 5, & 6, etc., and years 5, 6, & 7, etc. The last level is composed of only two test ages, 17 & 18 years. Each child's score is the average of all tests taken by him for the ages included in that level" (1, p. 181).

The orthogonally rotated factor loadings found by Hofstaetter are given in Table 1. Hofstaetter comments about them: "In some 15 years of factorial work this writer has never seen a more beautiful set of factor loadings; i.e.,

TABLE 1
HOFSTAETTER'S LOADINGS OF THREE FACTORS ON THE AGE-LEVEL STANDARD SCORES OF INTELLIGENCE (TIMES 100)

Test number	Average age (months)	Orthogonally rotated loadings I	II	III	Communality (h^2)
1	2	45	—48	03	43
2	5	77	—28	—04	67
3	8	88	—13	06	79
4	11	87	15	18	81
5	14	80	46	10	86
6	21	53	54	39	72
7	32	35	65	50	79
8	48	03	57	68	78
9	72	00	36	90	94
10	108	02	07	97	94
11	144	08	02	96	93
12	180	00	00	98	96
13	210	18	05	94	91

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one that shows as much regularity as the one presented here" (4, p. 159). He also shows the age trends revealed by the factor loadings in a figure which is redrawn in Figure 1.

In 1958, Sontag, Baker, and Nelson (6) published a table of intercorrelations of *IQ*s based on Stanford-Binet Forms L and M given to the same group of 50 boys and girls between the ages of 3 and 12. This table is reproduced in Table 2. Seven of the testings were with Form M; three, with Form L.

TABLE 2
FELS INTERAGE BINET CORRELATIONS (TIMES 100)

		Form and Age								
		M	M	M	L	M	L	M	L	M
Form	Age	4	5	6	7	8	9	10	11	12
M	3	83	72	73	64	60	63	54	51	46
M	4		80	85	70	63	66	55	50	43
M	5			87	83	79	80	70	63	62
M	6				83	79	81	72	67	67
L	7					91	83	82	76	73
M	8						92	90	84	83
L	9							90	82	81
M	10								90	88
L	11									90

All of the tests were given by the same person. The successive mean *IQ*s varied between 118 and 127.

A factor analysis by Thurstone's centroid method yields the factor loadings in Table 3. After the extraction of two factors, the residuals are negligible, none higher than .08 and 98 per cent of them less than .05. Plotting the points represented by the two factor loadings as coordinates revealed that the points were arranged in approximately the arc of a circle with 0,0 as the center. Rotating the axis around 0,0 so that the loading of Factor 2 in Test 12 is zero makes all of the loadings of the tests positive. The numerical values of these orthogonally rotated loadings are also given in Table 3.

By age 48 months, the loading of Hofstaetter's Factor 1 had become zero, the point at which it stayed for the later ages. Therefore, it is not surprising that neither of the present factors is similar to that one. The second factors in the two studies show great similarity for the ages that are present in both studies. Hofstaetter's Factor III and the present Factor I also are similar. Figure 1 shows the age trends of the factor loadings of Hofstaetter's three factors and the two factors of present study.

The correlations used by Hofstaetter were those between the means of standard scores for three consecutive test ages. In the same article, Bayley gives

TABLE 3
Factor Loadings of Stanford-Binet *IQs* (Fels) and of *IQs* from Various Tests (Berkeley Growth Study)

Age	Test	Unrotated loadings		Rotated loadings			Test	Unrotated loadings		Rotated loadings		
		I	II	I	II	h^2		I	II	I	II	h^2
3	S-B, M	74	41	50	68	77						
4	S-B, M	78	50	49	78	87						
5	S-B, M	88	24	69	59	86						
6	S-B, M	90	26	70	62	88	1916	86	32	77	49	84
7	S-B, L	92	—02	84	37	86	1916	89	22	82	40	84
8	S-B, M	93	—21	93	20	93	S-B, L	94	12	89	32	89
9	S-B, L	93	—14	90	26	88	S-B, L	92	11	88	30	86
10	S-B, M	90	—34	96	07	92	S-B, M	94	12	89	32	89
11	S-B, L	85	—36	92	04	88	S-B, L	96	—08	96	12	92
12	S-B, M	83	—39	92	00	86	S-B, M	94	—06	93	14	88
13							T-M, C	96	—08	96	12	92
14							S-B, L	94	—11	94	09	90
15							T-M, D	92	—20	94	00	88
16							W-B	94	—10	94	10	89
17							S-B, M	94	—13	94	07	90
18							W-B	94	—18	96	02	92

a table of correlations between mental test *IQ*s given at ages 6 through 18. A factor analysis of that table of intercorrelations yields factor loadings in two factors which, rotated, approximate even more closely the loadings from the Sontag, Baker, and Nelson intercorrelations. These also are shown in Table 3 and Figure 1.

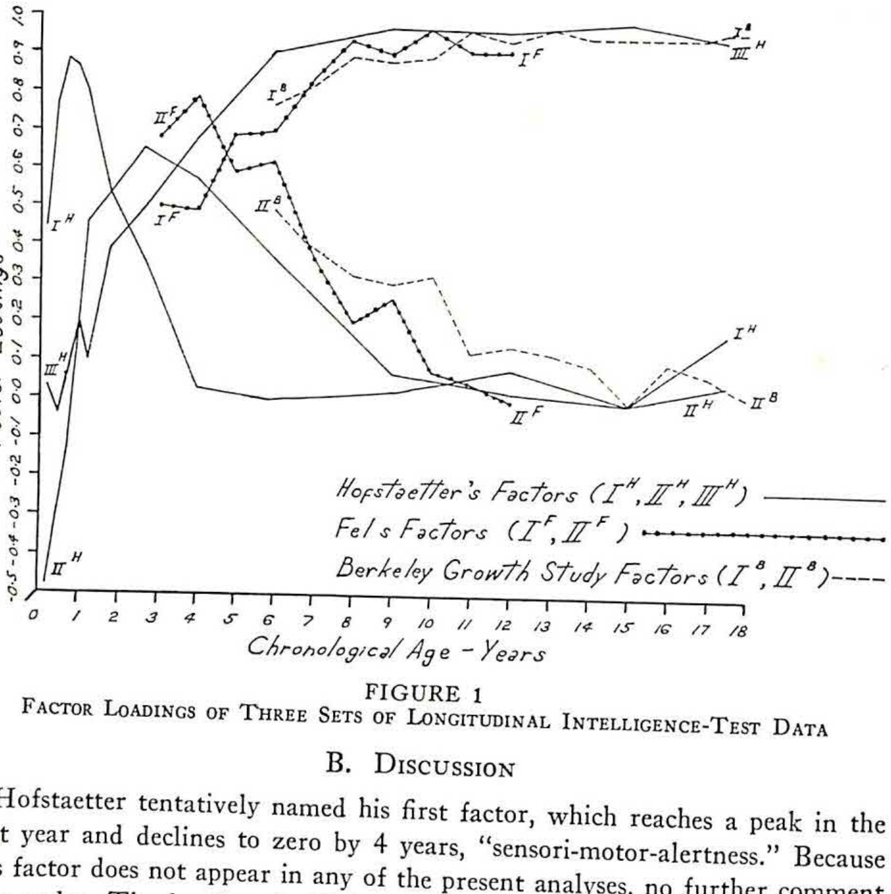

FIGURE 1
FACTOR LOADINGS OF THREE SETS OF LONGITUDINAL INTELLIGENCE-TEST DATA

B. DISCUSSION

Hofstaetter tentatively named his first factor, which reaches a peak in the first year and declines to zero by 4 years, "sensori-motor-alertness." Because this factor does not appear in any of the present analyses, no further comment is in order. The loadings in Hofstaetter's second factor are negative during the first year, reach a peak at around 3 years, and gradually decline, reaching zero about 9 years. He named this factor "persistence" or "rigidity." The third factor accounts for almost all of the variance of the tests from 48 months on. Hofstaetter named it "abstract behavior," "planning," or "general intelligence."

"Persistence" or "rigidity" seem questionable names for the second factor since these qualities are not tested to any greater extent in the preschool years when the loadings in this factor are higher than later on, when the loadings are zero. I suggest that this is a nonverbal factor (or factors) because of the nature of the subtests present in the tests used in the age range from 3 to 6. Bradway (2) has classified the subtests in Forms L and M of the Stanford-Binet into four groups. Approximately one-third of the subtests (including the alternates) in Form M, from II-6 through IV-6, Bradway classified as nonverbal. These tests include motor coordination, stringing beads, drawing a vertical line, sorting buttons, matching animal pictures and objects, and completing the picture of a bird. Items similar to these are not present at the upper age levels of the Stanford-Binet. Even the performance items of the Wechsler Intelligence Scale for Children (included in Bayley's battery of tests) are not of the same order as these nonverbal items concentrating between year-level II-6 and IV-6 of the Stanford-Binet.

Hofstaetter named his third factor "Manipulation of symbols," "abstract behavior," or "planning." Davis (3) has assigned about 50 per cent of the subjects in the upper levels of the Stanford-Binet (AA to SA III) to a category she calls "reasoning," about 25 per cent to "memory," and 25 per cent to "vocabulary." Practically all of them have verbal content. So Hofstaetter's name for this factor might be improved if it were called "manipulation of verbal symbols," or possibly "symbolic reasoning," or "verbal reasoning."[1]

C. SUMMARY

Two sets of intercorrelations between *IQ*s earned by the same group of children studied longitudinally over periods of several years have been analyzed by means of Thurstone's centroid method of factor analysis. One set was based on the performance of 50 3- to 12-year-old children on Forms L and M of the Stanford-Binet; the other, on several different tests between the ages of 6 and 18, with the number of individuals unstated but probably less than 40.

Both analyses yield two factors the loadings of which, at successive ages, are highly similar to each other and to Factors II and III of Hofstaetter's analysis of a table of intercorrelations between tests given between the ages of one month and 18 years. These two factors are tentatively named Nonverbal Ability and Symbolic Reasoning.

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[1] Since submitting this manuscript for publication, I have found Hunt's footnote (4, pp. 304-305) regarding Hofstaetter's study. Hunt points out that loadings in Hofstaetter's Factor II (which parallel those of Factor II of the present study) become positive at about the time that Piaget observed in his children interest in events for themselves. Similarly, Hunt relates the beginning of the increase of the size of loadings in Hofstaetter's Factor III (the present Factor I) with the beginning of what Piaget calls "concrete operations." Also, like Hofstaetter's analysis, the present one does not show a new factor arising at the beginning of Piaget's period of formal operations.

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RESPONSE SET IN IMPULSIVE CHILDREN*[1]

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A. INTRODUCTION

Impulsivity in children is a characteristic of their behavior which, if it could be better understood and measured, might be used in the prediction of certain behavioral patterns. The concept of impulsivity has appeared in the writings of psychologists for many years, but this concept has been vague and mostly theoretical. Some investigators have devised tests of impulsivity for adults, but until 1959 there had been no attempt to construct an impulsivity scale for children.

The present research had its genesis in Sutton-Smith and Rosenberg's study (9) in which they sought to derive a scale that would reliably distinguish the most impulsive from the least impulsive children. The authors first derived two scales: one based on adult responses and one based solely on the responses of elementary-school children. After combining the two scales, using duplicated items only once, there emerged a third scale that contained 19 items. Each item was a self-descriptive statement to be answered either "yes" or "no" by the child. The higher a child scored, the more impulsive he was considered to be. This scale was validated by using teacher ratings with a sample of 171 fourth-, fifth-, and sixth-grade school children. The test-retest reliability was .85. Grade level was not found to be uniformly influential in determining performance on the scale. However, boys tended to score significantly higher in impulsivity than did girls. Although the authors found that children who were viewed by their teachers as impulsive tended to score highest on the 19-item scale, it was not determined whether this agreement was a function of the inherent nature of the questions, or whether impulsive children demonstrate a response set and thus tend to answer affirmatively to self-descriptive statements in true-false questionnaires.

Cronbach (3) defined response set as "any tendency causing a person con-

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[1] This article is based on a thesis submitted to Bowling Green State University in partial fulfillment of the requirements for the degree of Master of Arts.

[2] The author acknowledges the assistance given him by John T. Greene, Brian Sutton-Smith, and Kurt Haas.

sistently to give different responses to test items than he would give when the same content is presented in a different form." Cronbach (3, 4) and others: e.g., Cohn (2), demonstrated that in true-false tests there is a response set of acquiescence. In other words, people tend to answer "true" more often than "false" on these tests. However, Jackson and Messick (6) found that a response set of acquiescence was not present in the California E and F scales. According to Cronbach, items in two different forms of the same tests (the true and the false) do not necessarily measure the same trait. He concluded that the score of a person is influenced by his set to react to the items in a certain way, apart from their content. Cronbach also noted that it might be possible to utilize response sets as personality measures by assuming that such sets are manifestations of basic traits. Lorge (7), for example, found that the tendency to circle "yes" on several tests correlated .27 with confidence scores on the Bernreuter Personality Inventory. He suggested that the tendency to respond in certain patterns may be symptomatic of a special aspect of personality.

B. PROBLEM

The purpose of this investigation was to study the test-answering behavior of children on modified forms of the Sutton-Smith, Rosenberg Impulsivity Scale for Children, specifically whether impulsive children demonstrate a response set by answering affirmatively to self-descriptive, true-false items. Because impulsives, by definition, respond quickly and without reflection, they may tend to circle the first answer in a series: e.g., "true" in true-false questionnaires. Because of the question of response set in impulsive children, this study was designed to test the hypothesis that impulsive children answer "true" to self-descriptive statements significantly more often than do nonimpulsive children. At the same time, new items were to be tried out so that some of them could be added to the original impulsivity scale, thereby lengthening the scale in an attempt to increase its validity.

C. METHOD

1. *Preparation of Test Materials*

To test the hypothesis of this study, it was necessary to reword each statement of the 19-item impulsivity scale, so that a response to each reworded item would have the same meaning as an opposite response to the original item. For example, a positive response, "yes," to the statement, "I like to keep moving around," has the same meaning as a negative response, "no," to the statement, "I don't like to keep moving around." However, after re-wording, several items seemed to acquire an added degree of intellectual difficulty. In the preceding example, a child would have to consider the following two possibilities before responding to the second statement:

> Yes, I don't like to keep moving around.
> No, I don't like to keep moving around.

This problem necessitated a pilot study in which the reversibility of items could be tested.

Each statement of the 19-item impulsivity scale was reworded. Eleven items that had just barely failed to reach significance in the study by Sutton-Smith and Rosenberg were also reworded for testing in order to check them as possible additional items which could be used to lengthen the final scale. A questionnaire was compiled that consisted of the preceding 30 items and their reworded counterparts. A few of the original items were reworded in more than one way, so that the number of statements on the questionnaire totaled 67 (these being randomly ordered throughout). The questionnaire was designed to be answered "true" or "false" rather than "yes" or "no" because it was felt that this method of responding would reduce some of the intellectual difficulty involved in the consideration of the statements.

The pilot-study population consisted of 58 male and female students from one fifth- and one sixth-grade classroom. Only students who were present on the day of testing were used.

Each child was given a copy of the questionnaire and told to read the instructions silently while the examiner read them aloud. The instructions were as follows:

> Decide whether each statement is true as applied to you or false as applied to you. If a statement is TRUE or MOSTLY TRUE as applied to you, circle the T. If a statement is FALSE or NOT USUALLY TRUE as applied to you, circle the F.

Occasionally, a student would fail to respond to a statement or answer it by writing in the word "sometimes." These contaminations were omitted in the tabulations for the item analyses; thus causing the number of students in the different analyses to range from 56 through 58.

Each item was tested against its counterpart (or counterparts) for the degree of correspondence of responses. Phi coefficients were calculated for each pair and then transposed into chi squares to check the degree of relationship between the items. It was decided in advance that only items that were significant beyond the .001 level would be selected for use in the major study. Nineteen items met the criterion. Thirteen of the remaining 19 items were from the original impulsivity scale and six were new items. These 19 items and their counterparts were the 38 statements that were used in the major study. Table 1 lists these items, giving the original statement first, followed by its inverse counterpart (in parentheses). Also listed in Table 1 are the six items that were omitted from the final study because they could not be reworded to insure semantically inverse meaning, but which were found to be valid statements on the original impulsivity scale.

2. *Final Test Forms*

The 38 statements that were derived from the pilot study were used to construct three forms of the final questionnaire. Form I contains the complete set of 19 items to which positive responses, "true," are scored as impulsive. Form II contains the complete set of 19 items to which negative responses, "false," are scored as impulsive. In other words, the items contained in Form II are the counterparts of the items contained in Form I. The items in both forms were arranged in the same random order. Nineteen items were randomly selected from Forms I and II, 10 items being selected from Form I and nine items from Form II. These 19 items were given the same random order as were the items in each of the preceding forms and called Form III. The purpose of Form III was to obtain a form which would be free from response-set variables in order to determine the effect of the questionnaire's content.

3. *Subjects*

The research population consisted of 127 male and female students from two fifth- and three sixth-grade classrooms. Only one of the classrooms, a sixth grade, had previously participated in the pilot study. Only students who were present on the date of testing were used. Four students who could not read at the fourth-grade level were not counted with the 127 students. The students within each classroom were randomly divided into three groups, and each group was given a different form of the questionnaire. The procedure for administering the questionnaire was identical to that used previously in the pilot study. Each classroom was tested individually.

4. *Ranking Procedure*

The teacher of each classroom ranked the students within each of the three groups according to the following definition of impulsivity:

> Impulsivity in children is the tendency of a child to respond quickly and without reflection or delay, to be restless, to indulge in horseplay, lose control of his feelings, break the rules, enter activities with over-

TABLE 1
IMPULSIVITY SCALE

No.	Item[a]	Response scored as impulsive
1.	I like to keep moving around.	T
	(I don't like to keep moving around.)	F
2.	I make friends quickly.	T
	(I don't make friends quickly.)	F
3.	I like to wrestle and to horse around.	T
	(I don't like to wrestle and to horse around.)	F
4.	I like to shoot with bows and arrows.	T
	(I don't like to shoot with bows and arrows.)	F
5.	I must admit I'm a pretty good talker.	T
	(I must admit that I'm not a good talker.)	F
6.	Whenever there's a fire-engine going someplace, I like to follow it.	T
	(If there's a fire-engine going someplace, I don't usually like to follow it.)	F
7.	My home life is not always happy.	T
	(My home life is always happy.)	F
8.	When things get quiet, I like to stir up a little fuss.	T
	(I usually don't like to stir up a little fuss when things get quiet.)	F
9.	I am restless.	T
	(I am not restless.)	F
10.	I don't think I'm as happy as other people.	T
	(I think I'm as happy as other people.)	F
11.	I get into tricks at Halloween.	T
	(I don't get into tricks at Halloween.)	F
12.	I like being "it" when we play games of that sort.	T
	(I don't like being "it" when we play games of that sort.)	F
13.	It's fun to push people off the edge into the pool.	T
	(It's not fun to push people off the edge into the pool.)	F
14.	I play hooky sometimes.	T
	(I never play hooky.)	F
15.	I like to go with lots of other kids, not just one.	T
	(I usually like to go with one kid, rather than lots of them.)	F
16.	I like throwing stones at targets.	T
	(I don't like throwing stones at targets.)	F
17.	It's hard to stick to the rules if you're losing the game.	T
	(It's not hard to stick to the rules even if you are losing the game.)	F
18.	I like to dare kids to do things.	T
	(I don't like to dare kids to do things.)	F
19.	I'm not known as a hard and steady worker.	T
	(I'm known as a hard and steady worker.)	F
20.	I like to just blow off steam.	T
21.	Sometimes I can hardly stop from throwing snowballs at people I see walking by.	T
22.	I don't think you should always have to do what you are told.	T
23.	I'll try anything.	T
24.	I usually say the first thing that comes into my head.	T
25.	I often act on the spur of the moment without stopping to think.	

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[a] Items 20 to 25 were omitted from the present study, but were found to be valid on the original impulsivity scale.

> whelming vigor, and generally to lose control in acceptable or unacceptable ways (8, 9).

To be sure that the teachers were well acquainted with their students, it was decided to use only teachers who had been instructing their students for at least three months prior to the requested ranking. Nevertheless, it was felt that an estimate of the validity of each teacher's ranking should be obtained. To this end, the researcher spent one full day in each classroom, independently ranking the children.

D. RESULTS

1. *Comparability of the Forms*

This study was principally designed to test the hypothesis that impulsive children answer "true" to self-descriptive statements significantly more often than do nonimpulsive children. To investigate this behavior it was necessary to compute a raw-score mean for each of the three forms of the final questionnaire. These means, if taken as discrete values, are identical (Table 2).

TABLE 2
IMPULSIVITY RAW-SCORE MEANS FOR EACH FORM

Form I		Form II		Form III	
N	Mean	*N*	Mean	*N*	Mean
42	8.33	43	8.20	42	8.20

2. *Validity of the Forms*

An additional objective of this study was to estimate the validity of the three forms of the questionnaire, each of which contains six new items and 13 items from the Sutton-Smith, Rosenberg scale. To this end, rank difference correlation coefficients were computed to determine if (within each group) a relationship existed between the teachers' rankings of the students and their ranked test scores. This procedure involved 15 correlation coefficients. Table 3 lists these coefficients and indicates that five of the 15 are significant at the

TABLE 3
CORRELATION COEFFICIENTS BETWEEN TEACHER RANKINGS AND RANKED TEST SCORES

	Teacher											
	A		B		C		D		E		Pooled ranking	
Form	*N*	*r*	*N*	*r*	*N*	*r*	*N*	*r*	*N*	*r*	*N*	*r*
I	9	.267	7	.518	8	—.143	8	.767*	9	.504	42	.407**
II	8	.446	9	.737*	8	.518	8	.733*	10	.381	43	.576**
III	8	.869*	7	.367	7	.375	9	.850**	9	.471	42	.584**

* Significant at the .05 level.
** Significant at the .01 level.

.05 level, one of these five reaching the .01 level. Also, the scores within each form were pooled and ranked. The teachers' rankings relating to each form were pooled and then correlated with the scores on each corresponding form. Table 3 also shows that each of the three correlation coefficients derived by pooling, is significant at the .01 level.

3. *Validity of the Teacher-Rankings*

Fifteen additional rank-difference correlation coefficients were computed to determine if a relationship existed between the individual rankings of each teacher and those of the examiner. Table 4 lists these coefficients and indicates that four of the 15 are significant at the .05 level. Each teacher's individual rankings were then pooled and correlated with the corresponding pooled rankings of the examiner. The resulting five coefficients are also given in Table 4. Four of these coefficients are significant at the .05 significance level, three of these reaching the .01 level.

TABLE 4
CORRELATION COEFFICIENTS BETWEEN TEACHER RANKINGS AND EXAMINER RANKINGS

	Teacher									
	A		B		C		D		E	
Group	*N*	*r*	*N*	*r*	*N*	*r*	*N*	*r*	*N*	*r*
I	9	.533	7	.857	8	.571	9	.250	9	.100
II	8	.452	9	.792*	8	.548	10	.757*	8	.410
III	8	.667	7	.179	9	.350	9	.767*	9	.617
Pooled	25	.550**	23	.661**	25	.463**	28	.666**	26	.377

* Significant at the .05 level.
** Significant at the .01 level.

E. DISCUSSION

The results obtained from the statistical analysis do not support the hypothesis that impulsive children answer "true" to self-descriptive statements more often than do nonimpulsive children. This conclusion derives from the fact that there is no difference between the raw-score means for each test form. The fact that the impulsives did not demonstrate a response set of acquiescence suggests that this type of response set does not constitute an important variable in this questionnaire. These results seem to contradict Cronbach's findings of a response set of acquiescence on true-false tests (3). Cronbach explained his findings by attributing to some students a tendency to respond "true" when in doubt, so that their score on true statements is low. If his explanation be correct, then the difference between the two sets of results is readily apparent. On the impulsivity questionnaire, there were no right or wrong answers. Consequently, the students did not have to guess, but needed only to appraise themselves according to their own self concepts. The fact that response sets of acquiescence did not appear on either the California E and F scales (6) or the impulsivity questionnaire does not refute Cronbach's findings, since the former three ask for attitudes and appraisals; whereas the tests Cronbach used called for correct responses.

All the coefficients derived by pooling the teachers' rankings and by correlating them with the pooled test scores on each form are highly significant; thus a relationship exists between the teacher rankings and the ranked scores of the students (Table 3). From the results discussed thus far, it is evident that the questionnaire (in any of its three forms) is able to differentiate high impulsives from low impulsives. Because the impulsives did not show a response set, it appears that the predictive value of the questionnaire is a function of its content rather than of the manner in which impulsive children respond to the statements.

The teacher rankings were the criteria against which the students' scores were correlated. As indicated in Table 4, there is a substantial relationship between the pooled rankings of the teachers and those of the examiner. Each of the three pooled coefficients is highly significant. Because there was only one teacher who was highly familiar with each student, the results (at best) are a tenuous validity estimate of the teacher rankings.

The fact that only five of the 15 "nonpooled" correlation coefficients in Table 3 are significant, and the fact that only four out of 15 "nonpooled" coefficients in Table 4 are significant, seemingly contraindicates high relationships between teacher ranking and test scores and between teacher and examiner rankings, respectively. However, the extremely small *N*s tend to minimize the meaningfulness of the correlations. On the other hand, the correlation coefficients derived by pooling utilize much larger *N*s, bringing the sample size closer to the population parameter. Also, 14 of the 15 "nonpooled" correlation coefficients in Table 3, and 15 of the 15 coefficients in Table 4, are in the positive direction and are (for the most part) substantially high. Therefore, it appears that, when the small *N*s are interpreted as a group, a tendency towards positive correlation can be seen.

Since the six new items contributed to the validity of the questionnaire, they should be retained. The six items that were not included on this questionnaire but that appear on the Sutton-Smith, Rosenberg scale might be added to the present questionnaire in order to lengthen it to 25 items. Since these six items cannot be reversed without creating an added degree of intellectual difficulty for elementary-school children, Form I should be used.

This would be the original impulsivity scale plus the six additional items. It is felt by the investigator that lengthening the scale should increase its validity substantially.

To test the validity of the proposed 25-item scale, further research is necessary. If ranking procedures are to be used, it would be well to obtain four or five persons who are highly familiar with each subject, so that a better validity estimate of the criteria can be obtained.

F. SUMMARY

The study tested the hypothesis that impulsive children answer "true" to self-descriptive statements significantly more often than do nonimpulsive children. At the same time, items were tried out so that some of them could be added to the Sutton-Smith, Rosenberg Impulsivity Scale for Children, thereby lengthening the scale to increase its validity.

A pilot study resulted in three forms of a 19-item questionnaire, the content of which was the same but which varied only in wording. The forms were administered to fifth- and sixth-grade students who were ranked on the trait of impulsivity by their teachers.

Mean scores for each form were found to be identical. These results showed that impulsive children do not tend to answer "true" to self-descriptive statements significantly more often than do nonimpulsive children.

Rank-difference correlation coefficients were calculated between pooled student scores on each form of the questionnaire and the corresponding pooled teacher rankings. Each of the resulting coefficients (.407, .576, and .584) was significant at the .01 level. A check of the teacher rankings showed them to be valid. It was concluded that the content of the questionnaire discriminates high-impulsive from low-impulsive children.

Six items which were not previously used in the Sutton-Smith, Rosenberg scale evolved from the study. It was suggested that further research is needed to test the Sutton-Smith, Rosenberg scale with the six additional items.

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EARLY TRAUMA, NUMBER OF ANIMALS IN A CAGE, AND AVOIDANCE LEARNING*[1]

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A. INTRODUCTION

Until recently there has been relatively little research on the effects of group housing upon behavior, although it has been more than 10 years since it has been explicitly recognized as a possible variable in experiments with animals. See Christie (3). A distinctive exception has been the long line of research devoted to studying the roots of maternal and sexual behavior and its relation to isolation of organisms at various ages: e.g., Beach (1). There has also been research dealing with the effects of crowding. The ecologist, for example, has been particularly interested in the effect of crowding upon general survival (4) and, stemming from Deevey's work, we have an account of how the crowding of pregnant mice influences the behavior of their progeny (6). Finally, there have been studies of the effect of litter size upon subsequent behavior; Seitz (7), for example, reared rats in litters of six or 12 and found differences between them for such variables as weight, hoarding, food competition, exploration, mating, fighting, and response to novel or startling stimuli. In contrast, he found no differences when he compared animals which were housed in similarly sized groups as adults.

The present study arose out of an interest in the influence of multiple housing where there is minimal crowding. It was initiated partly because of a practical problem, one solution to which was the possibility of multiple housing of animals in our laboratories. For several years, we have been engaged in a research program dealing with the effects of early experiences (trauma, handling, gentling, etc.) upon subsequent learning and exploratory behavior. Ordinarily, long intervals intervene between treatment experiences and test experiences; animals which are "put on ice" accumulate to large numbers (even if a few studies are being conducted) and create a serious space problem. As a result, we were interested in the possibility of housing animals

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in groups of two or three; hence, saving considerable space. Rather than institute such a laboratory procedure arbitrarily, we decided to investigate directly the effect on test behavior of multiple housing. A second factor was, in one sense, the inverse of the concern about group housing. We were interested in whether solitary housing had any deleterious influence upon subsequent learning relative to that of animals reared with a small number of companions. To make the results even more pertinent to our research, animals were traumatized at an early age; thus permitting a direct comparison with previous findings.

B. METHOD

1. *Subjects*

*S*s were 60 albino rats of the Sprague-Dawley (Holtzman) strain bred at the University of Oregon laboratories. *S*s were grouped as in Table 1.

TABLE 1
DESIGN OF EXPERIMENT*

Item	Solo	Placement Duet	Trio	Total
Males	5	10	15	30
Females	5	10	15	30
Cages	10	10	10	30

* Cages are the unit, not individuals.

2. *Apparatus*

The two major pieces of apparatus have been thoroughly described elsewhere (2). One was a shock box; the other, an escape-avoidance alley with a shock-grid floor was altered by the addition of a slit in the walls, seven and one-half inches from the start box, through which a photoelectric cell switching beam passed.

3. *Procedure*

*S*s were weaned at 21 days of age[2] and, on the same day, they were placed in the shock box individually and given a one-milliamp constant-current shock for two consecutive minutes. The same trauma procedure was followed for a total of five days. After the first trauma session, *S*s were placed into preassigned home cages, one, two, or three of the same sex to a cage.

After the five days of trauma, *S*s remained in the cages assigned to them throughout the remainder of the experiment; they were not handled between trauma and testing.

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[2] Cages and racks were manufactured by Bussey Products, Chicago; Rodere, front-opening, no-pan cages (Model No. 409), and 50-cage Rodere racks (Model No. 410), 3½" outside feeders (Model No. 427a), and standard water bottles were used.

Testing began when *S*s were 97 days of age. *S*s were given an escape-avoidance task to test for the effects of differential housing; the tests continued for eight consecutive days, the escape-avoidance alley being used. Each *S* was tested five times a day. At the beginning of each day's session, the rats to be run were removed from their home cages and placed individually in transport cages similar to the home cages. A trial consisted of *S* being placed in the start box for a two and one-half-second delay period, after which the start-box door was quickly raised; this closed a timing switch and initiated a timing circuit that switched on a one-milliamp current (the same strength as used during trauma) in two seconds. Avoidance of the shock was possible by running down the alley (which would also be charged after two seconds) to the goal box. Noncorrection was used by lowering doors behind *S* as he left the start box and entered the goal box. *S* was removed from the goal box after a five-second delay and returned to the transport cage. The intertrial interval was three minutes; after the fifth trial, *S* was replaced in his home cage after a mean waiting time of two minutes in the transport cage. Starting time and alley running time were measured by means of photoelectric cell and floor-plate switches which controlled standard electric clocks.

C. RESULTS AND DISCUSSION

Separate analyses of variance with days, housing conditions, and sex as the main effects were performed for starting speed and alley running speed. The unit of analysis was cage means rather than those for individual animals; thus, for example, in the trio group, the scores of the three *S*s were pooled and treated as one score. There were five cages to a subgroup because of the division by sex.

As expected, starting speed improved over the eight days of testing. However, there were no significant effects for the other two main variables or for any of the interactions.

In contrast, the analysis of alley running speed yielded significant differences at the .025 level or beyond for all main effects and for all the interactions except for day by sex. The detailed nature of the findings can be seen in Figure 1. The main effects for days is attributable to a drop in alley running speed from Day 1 to 2 for, thereafter, there are no substantial variations. This finding is in accord with that of Trapold and Fowler (8), who found that running speed flattens out by the fifth trial (the end of Session 1 in the present study). All the significant main effects and interactions for sex and housing can be attributed to the fact that the female trios ran much more slowly than the other female and all the male groups on Day 1, but not thereafter. By Scheffé's test, as described by Edwards (5), the female trios

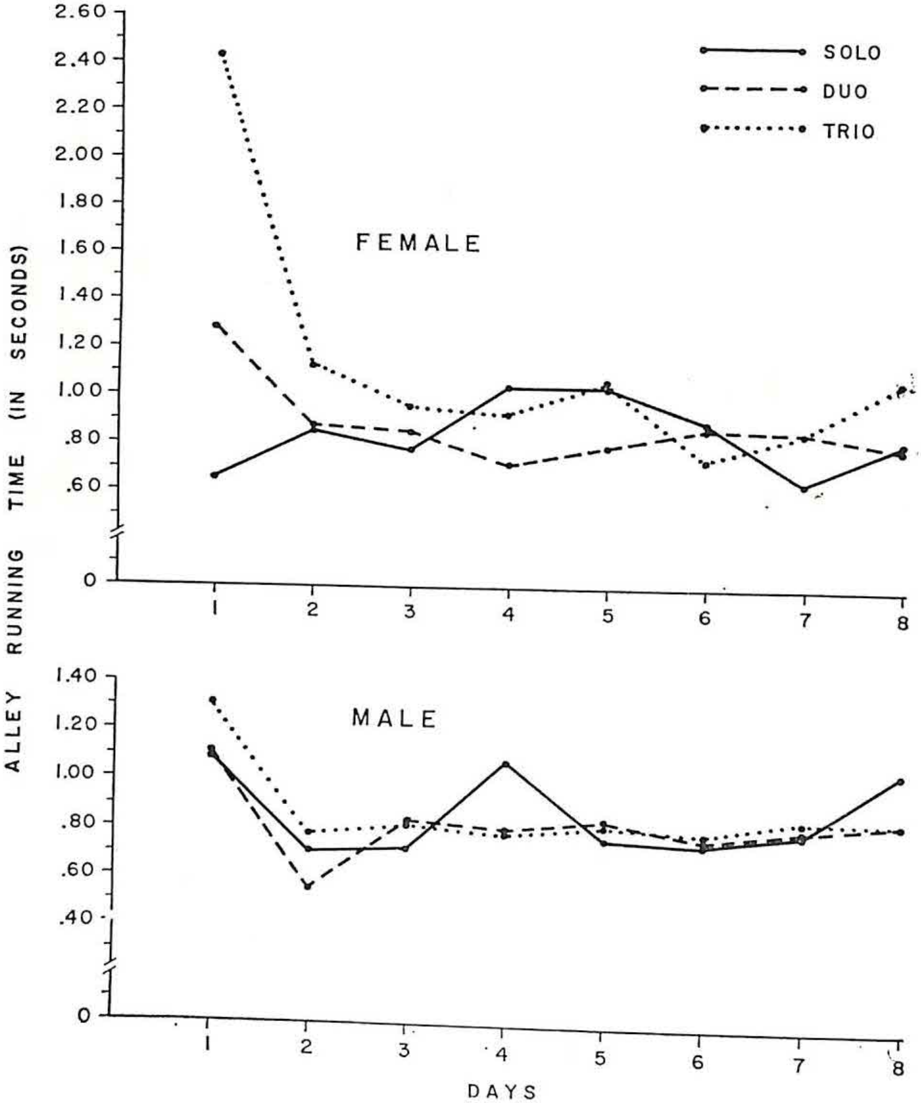

FIGURE 1
Alley Running Time. Running Time by Sex, Housing Conditions, and Days

differ significantly from the other five groups ($p < .001$), with no other comparisons being significant; there were no significant differences between groups on Day 2 or thereafter.

In several earlier studies [Brookshire, Littman, and Stewart, 1961 (2)] in which no distinction between running and starting speed was made, females uniformly had slower speeds. Since we know, on the basis of the present study, that females do not differ from males in starting speed, which continues to improve over time, it is likely that in the earlier studies the difference between male and female *S*s is attributable to differences in running speed. In the present study, only the female trios were slower than the males in running speed, the other two female groups being quite like the three male groups. As a result, it appears that the female solo and duo groups ran faster than one would have expected; so the problem is one of why the two female groups are so fast rather than one of why the female trios were so slow. We have no explanation to offer, though it seems unlikely that the housing condition is responsible, at least for the solo group, since (in the earlier investigations) animals were always housed individually.

D. Summary

Albino rats were weaned at Day 21 and subjected to two minutes of electric-shock trauma on Days 22 to 26. At the time of weaning, they were housed one, two, or three of the same sex to a cage. They were not handled until Day 97, on which day they were tested for escape-avoidance behavior in an alley runway for eight days, five times per day. There were no differences between groups in starting speed, though all animals improved in starting speed over the eight-day period. Females housed three to a cage had much slower running speeds than all other groups. It is suggested that this slower running speed is typical of female rats and that some undetermined factor had operated to increase the running speed of the solo and duo females over that ordinarily to be expected.

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THE CHILD'S PERCEPTION OF "THE TEACHER" AS COMPARED TO HIS PERCEPTION OF "THE MOTHER"*[1]

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A. PROBLEM AND BACKGROUND

The central problem of this study is the relationship between the child's perception of teacher and of mother. It is based on the theoretical assumption that childhood feelings and attitudes toward parents are displaced upon others and thus influence perception of others, as emphasized by the psychoanalytic concept of transference.

In a classic textbook on Freudian psychoanalytic theory, the phenomenon of transference is described as follows:

> The patient misunderstands the present in terms of the past. . . . He "transfers" past attitudes to the present (4, p. 29).

Similarly all psychoanalytic schools attribute to transference the meaning of a misinterpretation of present relationships in terms of past relationships (2, p. 518).

In summary it can be said that, according to the concept of transference, an element of distortion is introduced into the perception of present relationships, due to a predisposition to intepret the present in the light of the past.

Though the psychoanalytic literature on transference is rich in empirical observations based on clinical material, no experimental study of this central psychoanalytic concept has been published, so far as the present writer knows.

The study of the relationship between perception of teacher and perception of mother, and the extent to which such perceptions are related or independent, represents a preliminary but necessary step toward an experimental investigation of the concept of transference. Thus, if perception of teacher and perception of mother were to be significantly related, this relation would indicate less independent and therefore less objective perceptions than if no such relation existed. Therefore, a significant correlation between perception of teacher and perception of mother can be operationally defined as an "index of distortion" or a "transference component." It follows that, by studying the relationship between perception of teacher and of mother, the "transference component" in the child's perception of the teacher is also being investigated.

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[1] This is a condensation of a dissertation submitted in partial fulfillment of the requirements for the Ph.D. degree at Columbia University, 1963. The study was carried out with the guidance of Professor Arthur T. Jersild of Teachers College, Columbia University. The writer wishes to express her appreciation for his assistance.

Furthermore, by selecting the classroom as experimental setting we have a real-life situation in which the teacher, the present stimulus, is kept constant for all individuals; while the mother, the past (in the sense of antecedent) stimulus, is different for each individual. This parallels the situation between an analyst and his various patients, each patient perceiving the analyst differently.

This study attempts to answer the following questions: Is there a relationship between perception of teacher and perception of mother at the beginning of the school year, when the teacher is still an unknown entity? Does the child come to school with a predisposition to perceive mother and teacher similarly? Does this predisposition (if it exists) persist at the end of the school year, after several months of daily contact with the teacher; and is it greater and does it decrease less in children having a problem with authority in the classroom (e.g., by way of rebelliousness or submissiveness)? Will the children who exhibit problems with authority in the classroom parallel the case of the more disturbed individuals, who, in clinical practice, have been found to distort more and more persistently? Are behavior problems toward the authority figure in the classroom related to a greater and more persistent relationship between perception of teacher and perception of mother: i.e., to a greater "transference component"?

All of the foregoing theoretical questions have contributed to the formulation of the hypotheses tested in the present study. These hypotheses are as follows: (*a*) The child's perception of "the teacher" is related to his perception of "the mother," at the beginning of the school year. (*b*) The relationship between perception of "the teacher" and "the mother" is greater, at the beginning of the school year, in the case of children who exhibit problems with authority in the classroom (e.g., by way of rebelliousness or submissiveness). (*c*) The relationship between perception of "the teacher" and "the mother" persists at the end of the school year and decreases less in the case of children who exhibit problems with authority in the classroom.

B. Design and Procedure

1. *Subjects*

This investigation was carried out on two kindergarten classes in which all of the children had a common first experience with the same teachers, without having had any previous nursery-school experience. The total sample consisted of 75 children between the ages of 5 and 6. There were 33 boys and 42 girls. The classes were in a public school in Flushing, New York, in a lower-income neighborhood. Ethnically, the sample consisted predominantly of Catholic children of Irish and Italian descent with about an equal proportion of Protestant and Jewish children.

2. *Method*

To get expressions of the child's perception of "the teacher" and "the mother" incomplete stories were devised about teacher-pupil and mother-child situations. The child was asked to respond to the question "What will teacher (or mother) say (or do)?" The stories (12 on teacher and 12 on mother) cover a wide range of situations, centering, however, on the role of the authority figures as "disciplinarian" and as "helper." On this basis two scales were devised for mother and two for teacher: the "Discipline" and the "Helpfulness" scales.

This "structured projective test" was modeled after the incomplete stories used by Biber and Lewis in their study of children's expectations from their teachers (3). Whenever appropriate, stories used by Biber and Lewis were incorporated, with slight revisions, into the "Helpfulness" and "Discipline" scales on Teacher. Identical or very similar situations had to be written for the Mother. The administration of the scales was preceded by the following instructions:

> I'll tell you a few stories. I'll read the beginning of the story and you'll guess the end. It's like a story guessing games. I'll start the stories and you'll finish them. Now let's try it.

a. Scoring system. The concept of helpful and democratic authority figure, which is at the basis of the scoring system, conforms to Ausubel's description of "the permissive-democratic approach in interacting with children and managing child care routines" (1, pp. 351-352). In its final revision, the scoring system is not dependent on subtleties of language; but is based instead on concrete categories of behavior described by the children. According to the scoring system, a score of nine is assigned to the most helpful or most democratic type of response and a score of one to the least democratic or least helpful type of response. The midpoint is at five. The correlation between the scoring by the tester and by an independent rater is .93 for teacher and .97 for mother on the Helpfulness scale; .97 for teacher and .88 for mother on the Discipline scale.

b. Validity and retest reliability. In discussing validity in relation to the method of "direct subjective inquiry," Ausubel points out that the data collected by this method (whether perceptions, attitudes or judgments) are themselves the phenomena under investigation and are not intended as some indirect measure of more global traits. He concludes that, since no really independent measure of perceptual content is available, the best criterion of validity in such cases is test reliability (1, pp. 155-156). The correlation between the test-retest on the Discipline scale is .53 for teacher and .53 for mother; on the Helpfulness scale it is .66 for teacher and .79 for mother. These reliability coefficients do not compare unfavorably with the reliabilities of other projective techniques (5), especially if one keeps in mind that the subjects were 5- to 6-year-olds.

3. *Experimental Procedure*

The children were individually tested at the beginning and at the end of the school year. Test I was administered four weeks after the opening of the school year and Test II about seven months after Test I.

To compare the relationship between perception of teacher and perception of mother between children who exhibited problems toward authority in the classroom and those who did not, toward the middle of the school year the teachers rated the children as cooperative, submissive and rebellious. All the criteria selected pertained to classroom behavior readily observable by the teachers.

The product-moment correlation was computed for perception of teacher and perception of mother.

C. Results and Conclusions

1. *Tests of the Hypotheses*

The results of the tests of the hypotheses confirm the existence of a relationship between perception of teacher and perception of mother, at least for children at the kindergarten level.

The relationship between perception of teacher and perception of mother (as Disciplinarian and Helper) exists at the beginning of the school year, when the teacher is still an unknown entity; it persists at the end of the school year, in spite of the opportunities for reality testing provided by several months of daily experience with the teacher in the classroom. The significant positive correlations on which these conclusions are based are presented in Tables 1 and 2.

TABLE 1
RELATIONSHIP BETWEEN PERCEPTION OF TEACHER AND PERCEPTION OF MOTHER AT BEGINNING OF SCHOOL YEAR FOR TOTAL SAMPLE ON DISCIPLINE AND HELPFULNESS

Scale	*N*	Teacher Mean	Teacher *SD*	Mother Mean	Mother *SD*	*r*	*z*	*p*
Discipline	75	3.9	1.3	3.8	1.2	+.50	4.30	<.001
Helpfulness	75	6.2	1.0	6.3	1.2	+.45	3.87	<.001

TABLE 2
RELATIONSHIP BETWEEN PERCEPTION OF TEACHER AND PERCEPTION OF MOTHER AT END OF SCHOOL YEAR FOR TOTAL SAMPLE ON DISCIPLINE AND HELPFULNESS

Scale	N^a	Teacher Mean	Teacher *SD*	Mother Mean	Mother *SD*	*r*	*z*	*p*
Discipline	63	3.7	1.1	3.9	1.1	+.52	4.10	<.001
Helpfulness	63	7.0	0.9	6.6	1.2	+.44	3.46	<.001

[a] Twelve children were unavailable for retesting.

For children who exhibit problems with authority in the classroom, as compared to those who do not, the relationship between perception of teacher and perception of mother, at the beginning of the school year, is greater with respect to their perception of the authority figures as Disciplinarian but not as Helper. Correlations are presented in Table 3.

Since the Discipline variable is more directly related to behavior toward authority in the classroom, on which the breakdown into cooperative and submissive-rebellious was based, it can be concluded that a closer relationship between perception of teacher and of mother occurs for the variable more

TABLE 3
RELATIONSHIP BETWEEN PERCEPTION OF TEACHER AND PERCEPTION OF MOTHER AT BEGINNING OF SCHOOL YEAR FOR COOPERATIVE AND SUBMISSIVE-REBELLIOUS ON DISCIPLINE AND HELPFULNESS

Group	Boys	Girls	N^a	Discipline *r*	Discipline *z*	Discipline *p*	Helpfulness *r*	Helpfulness *z*	Helpfulness *p*
Cooperative	15	22	37	+.33	1.98	.024	+.52	3.12	<.001
Submissive-rebellious	16	21	37	+.72	4.92	<.001	+.45	2.70	.004

[a] *N* for both groups combined is 74 instead of 75 for the total sample because of the absence of one child at the time of rating.

directly related to problems with authority in the classroom or, at any rate, to the criteria for selecting them.

By the end of the school year, the significantly closer relationship between perception of teacher and perception of mother as Disciplinarian no longer exists for the submissive-rebellious group. Though the relationship between perception of teacher and of mother persists for both the cooperative and the submissive-rebellious groups, changes have occurred in this relationship in each group which, though not statistically significant, result (by the end of the year) in an equalization of this relationship between the two groups. Correlations are presented in Table 4.

TABLE 4
RELATIONSHIP BETWEEN PERCEPTION OF TEACHER AND PERCEPTION OF MOTHER AT END OF SCHOOL YEAR FOR COOPERATIVE AND SUBMISSIVE-REBELLIOUS ON DISCIPLINE AND HELPFULNESS

Group	Boys	Girls	N[a]	Discipline			Helpfulness		
				r	z	p	r	z	p
Cooperative	11	21	32	+.61	3.35	$<.001$	+.35	1.98	.024
Submissive-rebellious	11	19	30	+.51	2.79	.003	+.51	2.79	.003

[a] Five cooperative and seven submissive-rebellious children were unavailable for retesting.

This equalization may be attributed to the reactions of the cooperative, who show a greater correlation at the end of the year than at the beginning (though not significantly so) between perception of teacher and mother as Disciplinarian. The cooperative children may perceive teacher and mother more closely as they gradually relate more to their classroom teacher; thus paralleling the behavior of relatively healthier individuals in therapeutic situations.

2. *Further Results and Conclusions*

Results not directly bearing on the hypotheses are as follows:

1. Patterns of perception were specific for each variable. Intercorrelations between Discipline and Helpfulness for perception of teacher and of mother, at the beginning and end of the year, yielded negative results. This confirmed the conclusion that the Discipline and Helpfulness variables were independent of each other.

2. Teacher and mother were both perceived as "Undemocratic" but "Helpful," at the beginning and at the end of the year, by the cooperative as well as by the submissive-rebellious.

3. The relationship between perception of teacher and of mother was stable in spite of unstable images of mother and teacher.

4. The highest degree of perceived similarity between teacher and mother, which also persisted the most, was evoked by stories involving aggression or defiance of teacher and mother and was predominantly in the form of expectations of physical and violent punishment.

Thus, 38 per cent of the children at the beginning of the year and 40 per cent at the end of the year showed expectations of physical and violent punishment from both teacher and mother in answer to "child hits adult." Since there was no reason to believe that the teachers inflicted violent physical punishment, it was concluded that the children's expectations of such punishment were unrealistic, as far as the teachers were concerned, and reflected a distortion in their perception.

Furthermore, since this distorted perception of teacher was related to perception of mother, it was considered to be rooted in the children's earlier subjective experiences with their own mothers. Thus, 75 per cent of the children, both at the beginning and at the end of the school year, showed expectations of physical and violent punishment from the mother. This high percentage does not necessarily reflect, accurately, home practices; but rather, the children's subjective view of their interaction with their mothers, as well as their own conscience or "superego." This points to the need for a systematic exploration of the role of the superego in unrealistic expectations of punishment and in the distortion of perception in interpersonal relations.

It should be noted that the results of this study, based on a "direct subjective inquiry" conform with the findings of studies using "objective approaches," such as recent studies on parental attitudes in relation to social class (1, p. 351) and an earlier study on patterns of parent behavior (2). They also are in accord with the findings of the Biber and Lewis study regarding children's expectations from their teachers, which pointed to the punishment area as one in which the children's responses were the most unrealistic (3, p. 65).

D. DISCUSSION

1. *Limitations of Study*

A basic limitation of the present study, which applies likewise to all correlational studies, is that it cannot answer questions of causation. Thus, this study cannot distinguish the extent to which the relationship between perception of teacher and mother is due to the child's past experience with his mother—as emphasized by the concept of transference—or to inherited or constitutional factors that might predispose a child's reactions to other people, whether they be parents or teachers.

However, in re-evaluating the study in the light of its particular limitations, it appears that the only weakness that casts doubt on one of the conclusions is the lack of a second rating by the teachers, at the end of the school year, on cooperative, submissive and rebellious children. Since the rating made in the middle of the year may no longer reflect the situation prevailing at the end of the year, this could account, in part, for the fact that at the end of the year the submissive-rebellious no longer showed a significantly greater correlation between perception of teacher and of mother as Disciplinarian.

2. *Concluding Statement*

The findings indicate that, whatever the cause (whether due to experiential factors or to an interaction between inherited, constitutional, and experiential factors), there is a considerably larger correspondence than could be expected by chance between kindergarten children's perceptions of their teachers and their mothers.

By collecting evidence on the existence of a relationship between perception of teacher and perception of mother, both at the beginning of the year (when the teacher is still an unknown entity) and at the end of the school year (after several months of daily experience with the teacher), this study also presents evidence in favor of the concept of transference, as formulated in terms of "predisposition" and "distortion" which tend to persist.

From the point of view of this formulation, it can be said that this study constitutes a preliminary step toward an experimental investigation of the "transference component" in the child's perception of the teacher.

E. SUMMARY

This study investigated the relationship between the child's perception of teacher and mother.

It was based on the theoretical assumption that childhood feelings and attitudes toward parents are displaced upon others and thus influence perception of others, as emphasized by the psychoanalytic concept of transference.

It was postulated that evidence of such transference would appear in children's perceptions of their teachers.

A significant correlation between perception of teacher and mother was

operationally defined as an "index of distortion" or a "transference component."

It was hypothesized that a relationship between the child's perception of teacher and mother would exist at the beginning and persist at the end of the school year. This would be greater and decrease less for children who exhibit problems with authority in the classroom.

Seventy-five kindergarten children were individually tested, at the beginning and end of the year, by means of incomplete stories, centered on the role of teacher and mother as "Disciplinarian" and "Helper." In the middle of the year the teachers rated the children as cooperative, submissive, and rebellious.

Significant positive correlations between perception of teacher and mother, as Disciplinarian and Helper, at the beginning and end of the year, confirmed the existence and persistence of the hypothesized relationship for kindergarten children.

The submissive-rebellious showed a significantly greater correlation for perception of teacher and mother as Disciplinarian only and only at the beginning of the year.

The highest degree of perceived similarity between teacher and mother, which also persisted the most, was evoked by stories involving aggression and defiance of the adults and was predominantly in the form of expectations of physical and violent punishment.

Since there was no reason to believe that the teachers inflicted violent physical punishment, it was concluded that these expectations were unrealistic and reflected a distortion in the children's perception of the teacher which was related to their perception of mother.

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HEAD TURNING IN THE HUMAN NEONATE: SPONTANEOUS PATTERNS*[1]

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A. INTRODUCTION

The analysis of behavioral organization in any organism requires the identification of recurring and objectively observable patterns of functioning. In the human infant the spontaneously occurring head-turning response represents such a pattern. It has therefore been utiliized as a measure of fetal development (4) and as an indicator response in studies of neonatal conditioning (9). Despite the fact that the head-turning response seems to fulfill the requirements for a variety of behavioral inquiries and would therefore seem to require a detailed analysis of its characteristics, such a detailed analysis has yet to be undertaken.

The most complete consideration of this behavior pattern thus far offered is that of Prechtl (12). However, the nature of this analysis (as well as the methodological approach that was utilized) reflects certain theoretical assumptions. Because, in our view, these assumptions are questionable it was thought necessary to re-examine the organization of the spontaneously occurring neonatal head-turning pattern.

B. SUBJECTS

Twenty infants who were between 60 and 79 hours of age at the time of study were utilized in this experiment. All of the infants studied were full-term neonates between 2,600 and 4,020 grams in weight at birth. The general condition of the infants studied was good from the time of birth until the time of testing, as determined by Apgar scores of neonatal status (1). Eighteen of the infants (Table 1) had Apgar ratings of 7 or more and the absence of any notation of distress in their hospital records. The other two neonates in the sample showed clear signs of some distress at birth. Both

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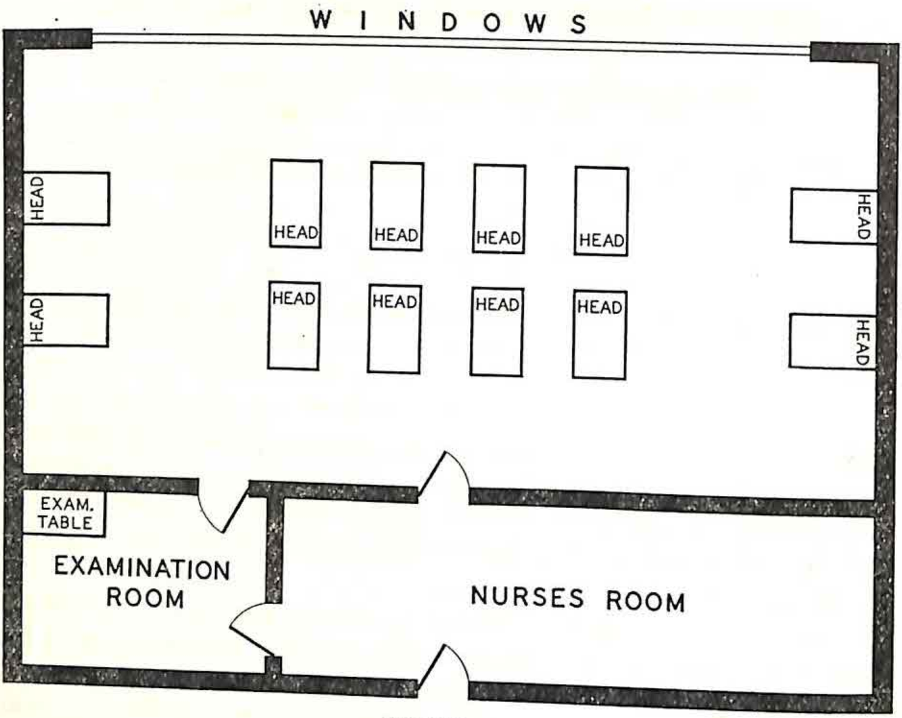

FIGURE 1
ARRANGEMENT OF NURSERIES

TABLE 1
POPULATION CHARACTERISTICS OF INFANTS OBSERVED

Apgar score	Male		Female		Total
	Negro	Caucasian	Negro	Caucasian	
4	0	2	0	0	2
7	1	0	0	0	1
8	1	1	1	0	3
9	1	5	4	3	13
10	0	0	1	0	1
Total	3	8	6	3	20

of these infants had Apgar scores of 4 and one of them was delivered by a breech extraction. The sexual and ethnic distribution of the 20 infants studied is 11 males, 9 females, 11 Caucasians, and 9 Negroes (Table 1).

1. *Housing*

All of the infants were housed in one of the four full-term nurseries in the Bronx Municipal Hospital Center. The four nurseries were identically arranged with a bank of outside windows along one wall and an entrance from a nurses' room in the opposite glass wall (Figure 1). An examination room with two entrances (one from the nursery and one from the nurses' room) was on the same wall as the nurses' room. Each infant was housed in its own bassinet and the bassinets were arranged so that there were two rows of four bassinets in the center of the nursery. At either end of the nursery were two additional bassinets placed so that the feet of the infants were toward the center of the nursery. Infants in the center rows were arranged so that their heads were toward the center of the room (Figure 1). Artificial light for the nursery was supplied when necessary by two overhead ceiling lights, one at each end of the center rows of bassinets.

2. *Observational Status*

All of the infants in this study were observed between 8:00 and 9:30 A.M. This period, and especially the latter half of it, was one of maximal activity in the nursery. During the period from 8:45 A.M. until 9:30 A.M., all of the infants were bathed, weighed, and dressed, and their bassinet linen was changed. At 9:30 A.M., the infants were brought into their mothers' room for feeding. The previous feeding was begun at 6 A.M. Two of the infants were observed twice on the same day, once between 8:00 A.M. and 8:45 A.M. (considered the midprandial condition) and once between 8:45 A.M. and 9:30 A.M. (considered the preprandial condition). Four subjects were observed only between 8:00 A.M. and 8:45 A.M. and 14 more subjects were observed only between 8:45 A.M. and 9:30 A.M. Thus, there was a total of 22 observations of 20 awake infants.

Infants who were sleeping as well as the infants who were awake were observed. However, the principal data to be considered were obtained from babies awake throughout the observation period.

C. PROCEDURE

Observations were made to determine the frequency and location of gross movements of the head and limbs as well as contacts between these body regions. Initially, each infant was observed in the nursery to determine its state (awake or sleeping, crying or quiet) and posture (prone or supine, head right or left of the body midline). It was then wheeled into the examination room in its bassinet, and any wrappings that would interfere with its free movement were undone. During this procedure, care was taken to minimize alterations of the infant's position in the bassinet to those necessary to place the infant in the supine position. To prevent a systematic directionalization of both ambient and light stimulation, the infants' bassinets were not positioned in the examination room in a uniform manner.

Records of movements were obtained simultaneously and independently by two observers—one stationed at the infant's feet and the other at the infant's head. The observer at the neonate's head continuously noted all gross movements of the infant's head and the area in which these movements occurred. Head position was scored in degrees from 0 to 180. The right cheek in contact with the substrate was considered as 0°. These observations were recorded on a check sheet having the categories 0°, $< 45°$, 45°, $< 90°$, 90°, $<135°$, 135°, $< 180°$, and 180°. The second observer noted all gross movements of the infant's limbs as well as any contacts of limb with head or face. The locus of contact in terms of right cheek, left cheek, nose, mouth, chin, or head was recorded by use of a coded notation. The second observer also noted such behaviors as crying, sneezing, or yawning.

All observation periods consisted of five one-minute units. These observations were subdivided into 10-second intervals with a 10-second pause between successive minutes of observation. The timing of the two observers was coordinated by a voice signal given every 10 seconds via a prerecorded dictaphone belt. The observations of both observers were recorded on time-ruled sheets. All observations were made by the same two observers who alternated positions for successive observations.

D. RESULTS

1. *Pattern of Head Turning*

The data obtained from observations of spontaneous neonatal head turning (i.e., head turning in the absence of experimental intervention) were analyzed in order to identify characteristic patterns of response. While previous reports (12) suggested that the side-to-side head turn in human neonates constitutes a stereotyped pattern of response, no infant in our population exhibited a pattern of responses that could be considered stereotyped. Instead, at least three neonatal head-turning patterns could be distinguished on the basis of degree and lateralization of turning. The first was a pattern (Type 1) in which the infant turned its head to both sides of its body midline. The second was a pattern in which the infant's head did not cross its body midline. The second pattern was divided into two subpatterns in one of which the baby's head movements were limited to an arc of 90° or less (Type 2) and another subpattern (Type 3) in which the range of movements did not exceed an arc of 45°.

Of the 20 infants observed, only three exhibited the Type-1 pattern of head movements. Two of the three infants exhibiting this pattern of head turning were observed twice during the same day. One infant showed this pattern (Type 1) on both observations, while the other exhibited it on only one occasion. None of the three infants observed to make Type-1 responses turned through the full arc of 180°. The 17 infants whose head movements occurred on only one side of the body midline were distributed as follows: head movements of nine of the infants were of the Type-2 variety; the remaining eight infants exhibited the Type-3 pattern.

In schematized form, Figures 2, 3, and 4 show the head-turning patterns

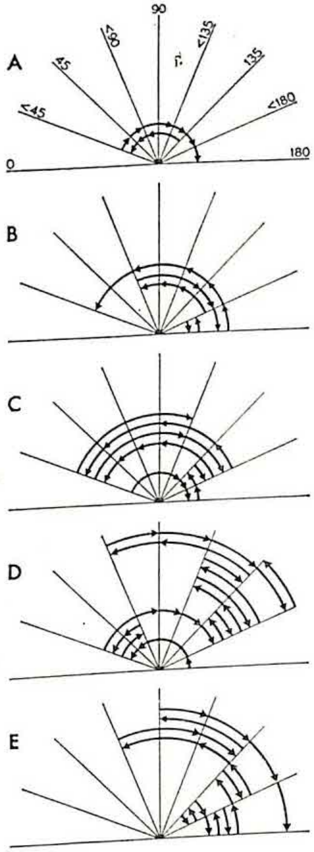

FIGURE 2
HEAD MOVEMENTS OF INFANT EXHIBITING TYPE-1 HEAD TURNING
(Explanation in text)

of infants exhibiting each of the three types of head-turning behavior. Each segment of Figures 2, 3, and 4 represents one minute of observation, with Segment A representing the first minute of observation and the next four segments representing successive minutes until the conclusion of the observation. The radii represent the angular deviations; the concentric arcs, the baby's head movements. The inner arc represents the initial movement, and each alteration in the direction of turning is represented by successively greater distances from the center of the circle. The direction of movement is noted

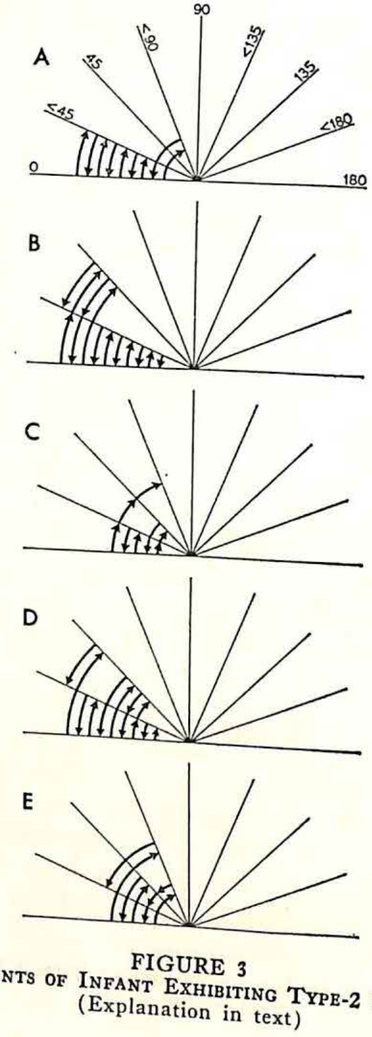

FIGURE 3
HEAD MOVEMENTS OF INFANT EXHIBITING TYPE-2 HEAD TURNING
(Explanation in text)

by arrowheads which also serve to indicate pauses of variable duration. Because there was a 10-second interval between each minute of observation, the terminal position for an observation of any given minute need not correspond to the initial position for the observation in the subsequent minute. In the interest of clarity, the diagrams are simplified. Observations were made in terms of < 45°, < 135°, and less than 180°. Thus, any turn up to 44° would be noted as less than 45°. In the diagrams, each turn to a position of less than 45° is represented as terminating at 22 1/2°. While head movements

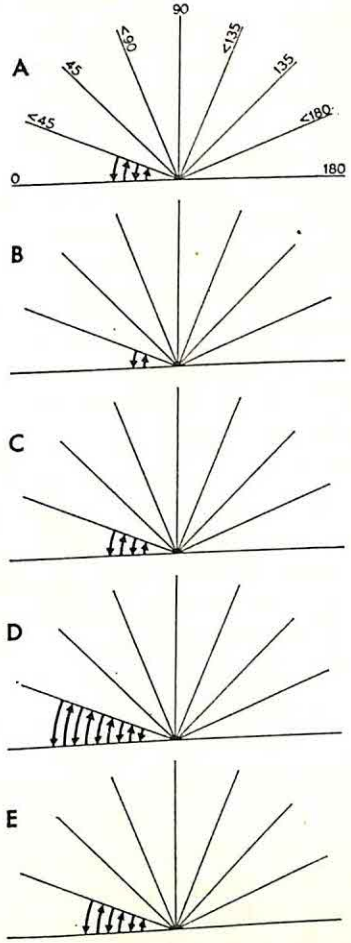

FIGURE 4
Head Movements of Infant Exhibiting Type-3 Head Turning
(Explanation in text)

within a segment were recorded on the observation sheet, they do not appear in the schematic figures. Similarly, head movements in the sagittal plane were recorded but are not shown in the diagrams. These eliminations are not serious since in no case were more than four of these movements made by any infant. It should be recognized, however, that simplification in the diagrams serves to make the patterns of head movements appear more uniform than is really the case.

The head-turning responses of the infant showing the greatest degree of head turning are shown in Figure 2. The amplitude of the turning arc prior to a pause or change of direction varied markedly from turn to turn. Certain of the turns (as can be noted in Figure 2) were broad continuous sweeps. But most were short turns followed by a pause and then a continuation of movement in the same direction or a reversal in the direction of head turning. While certain of the large turns in one direction were followed by a series of turns in the other direction, other of the large turns were followed only by short oscillations of the head. Moreover, the infant whose behavior is depicted in Figure 2 was not typical, even of the three infants showing Type-1 head movements. The other two infants in this group confined their head turns almost exclusively to short turns, one of them never turning through more than 45° on any single turn or more than 90° in any series of turns. In no infant was a regular alternation of head movements exhibited.

A record illustrative of the pattern of responses of infants showing the Type-2 pattern of head turning is presented in Figure 3. In this group of infants, short turns in one direction are characteristically followed by a pause and then by short turns in the opposite direction. Occasional longer turns were followed by pauses and then by a short turn in the opposite direction. Most of the time, the infant's right cheek was in contact with the substrate and excursions of the head occurred preponderantly within an area of less than 45° from that position. This posture and movement pattern was typical for all infants who exhibited the restricted types of head movement.

A pattern of head turning representative of those infants who limited their head movements to an arc of 45° or less (Type 3) may be seen in Figure 4. The short oscillating head turns characteristic of this group are evident from the figure. Figure 4 gives a somewhat misleading impression of turns of uniform amplitude. Turns labelled less than 45° represent a range from a minimal movement of the head to a turn of slightly less than 45°.

2. *Lateralization of Response*

Marked lateral preference in head position was noted in 18 of the 20 infants studied. Seventeen of the infants maintained their head to the right of the body midline *exclusively* and one of the infants had its head predominantly to the right of body midline. Two infants who exhibited Type-1 movements were observed twice, and each of these infants had its head to the left of the body midline more frequently than to the right of the midline during one of these observations. However, during one observation, one of these infants maintained his head to the right of the body midline *exclusively* and the other infant (who exhibited Type-1 movements during both observations) had its head predominantly to the right of the midline. Thus, the 18 infants who exhibited clear-cut lateral preferences in head position showed the same (i.e., right) preference, and no infant exhibited a clear-cut left-position preference.

The head posture of several hundred full-term infants up to four days of age was noted. All of these infants with the exception of three were found to be lying with their heads to the right of the body midline. The arrangement of the nurseries (see Figure 1) was such as to preclude any lateralized source of stimulation affecting all infants from the same direction. Incidental observations of the nurses' placement of the infants in their bassinets suggest that such placement was not the source of the uniformity of the lateral head orientation.

3. *Relationship of Head Turning to Motor Activity and Self-Stimulation*

To determine whether or not there was a cumulative effect of the observation procedure itself on the number of head-turning and limb movements, the number of these movements was tallied independently for each minute of observation, and the data so obtained were subjected to a Friedman two-way analysis of variance (13). Significant differences in the number of responses during the various minutes of observation were not found for either head or limb movements. Consequently, the five one-minute observations were treated as a unit on all subsequent analyses.

The method utilized in collecting data allowed an analysis of the relationships between head movements and limb movements for periods ranging from five minutes down to 10-second intervals. Even with the rather gross limits imposed by a five-minute period, certain relationships were found to obtain. Thus, the total number of head movements during an observation period is significantly correlated with the total number of arm movements (at better than the .05 level; $N = 20$, rho $= .420$).[2] The number of head movements is also significantly correlated with the number of times an infant's hand or arm touched its facial region ($N = 20$, rho $= .466$, $p < .05$).

If the correlation found between head movements and arm movements is due solely to the "fact" that both behaviors vary with the general level of activity of an infant, then a positive correlation between the number of head movements and the number of leg movements (which would also vary with the general level of activity) would be anticipated. But, for this last-named relationship, a negative nonsignificant correlation of .103 was obtained.

The pattern of responding noted during observation was also analyzed to determine the concomitance of the various behaviors during each separate observation.[3] In 12 of the 21 observations (see Table 2), the number of head movements made during each 10-second interval was found to be significantly correlated with the number of arm movements during the same interval. In five of the 16 observations for which a rho could be computed a significant correlation was found between the number of head movements in each interval and the number of times that the infant's face was touched by its arms or hands during that interval. While the overall correlation between head movements and leg movements for the total five-minute periods did not approach significance, eight of the 21 individual correlations of head

TABLE 2
NUMBER OF OBSERVATIONS ON WHICH SIGNIFICANT RANK-DIFFERENCE CORRELATIONS WERE FOUND WITH HEAD MOVEMENTS

Number	Arm movements	Facial contacts	Leg movements	Previous contacts
Number of significant correlations	12	5	8	7
Total number of computable correlations	21	16	21	16

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[2] Although the correlations are based upon 22 observations, only 20 infants are represented. To maintain the independent character of the observations, for each of the two infants that were observed twice single scores were obtained by summing the scores for the repeated observations and dividing by two.

[3] Correlation coefficients between head movements and other measures were not computed for one of the subjects because that infant did not turn its head sufficiently often to make such correlation coefficients meaningful. During five additional observations, facial contact did not occur with sufficient frequency to warrant the computation of correlation coefficients between head turning and the number of self-contacts.

movements with leg movements were sufficiently large to be significant beyond the .05 level. This difference between the group and the individual results suggests that, in the relationship between head and leg movements, there are marked differences between individuals or between particular periods.

In considering the relationship between head movements and facial contacts, the possibility exists that head movements (in part) are causally related to facial contacts. If this is the case, then the time relationship between facial contacts and head movements need not be one of concomitance. To test this possibility the rank-difference correlation coefficients between the number of head movements and the number of facial contacts during the preceding 10-second interval were computed. Seven of the 16 rhos computed were significant beyond the .05 level (Table 2). Five of the seven significant rhos were obtained from the same observations (Table 2) in which head turning and concomitant facial contact were found to be significant. This result suggests a wide range of latencies for head turning following facial stimulation. However, in view of the wide range of intensities of facial stimulation, all of which received the same frequency score, and the marked differences in the temporal distribution of these self-contacts, a wide range of latencies is not surprising.

4. *Effect of Infants' Condition: Feeding Status and Sleep*

Because previous workers (10, 11, 12) have reported a relationship between nutritional status and neonatal behavior, the current study was undertaken with feeding status as one of the independent variables. The number of head, arm, and leg movements made by infants during the midprandial period were not found to differ from the number of such movements made by infants during the preprandial period (Mann-Whitney *U* Test). No significant differences (Mann-Whitney *U* Test) were found between the mid- and preprandial periods in the number of self-contacts made. No significant differences in the proportion of significant to nonsignificant correlations between the mid- and preprandial periods were found (Fisher's exact-probability test, Table 3).

Four of the infants reported in the main body of the results were also observed while asleep. For these infants, all of the calculable correlations of head movements with arm or leg movements or with self-contacts were found to be significant. Thus, head and arm movements were significantly correlated in four cases, and head and leg movements in three cases. The number of head movements and the number of self-contacts in the same, or in the preceding interval, were significantly correlated in the single infant

TABLE 3
RELATION OF TIME SINCE LAST FEEDING TO THE CORRELATION BETWEEN HEAD MOVEMENTS AND OTHER MOTOR ACTIVITY

Number	Arm movements	Facial contacts	Leg movements	Previous contacts
		Midprandial Condition		
Number of significant correlations	3	1	3	0
Number of computable correlations	6	3	6	3
		Preprandial Condition		
Number of significant correlations	9	4	5	7
Number of computable correlations	15	13	15	13

that contacted its facial region with sufficient frequency to allow such a calculation to be made. The number of observations of sleeping infants, however, is too small to allow for a meaningful statistical analysis of the differences in the number of significant correlations obtained from an infant when awake and when asleep. But the findings suggest that relationships between head movements and other behaviors are as readily observable in sleeping infants as in waking ones.

5. *Other Factors*

Crying occurred during 15 of the 22 principal observations. To determine whether or not amount of crying had any systematic relationship to the behaviors in question, Spearman rank-difference correlations between the number of intervals in which crying occurred and the number of head movements, arm movements, leg movements, and self-contacts were computed. None of the rhos reached significance. The range of correlations was from —.164 (for crying and self-contact) to .265 (for crying and arm movements). Further analysis of the data failed to suggest the existence of sex differences or differences due to ethnic extraction. The two infants that had Apgar scores of 4 did not give extreme responses on any of the measures.

E. DISCUSSION

The most characteristic feature of spontaneously occurring neonatal head turning appears to be its variability with respect to amplitude, frequency, and sequence. This variability is nonrandom in nature because of limitations stemming from the marked lateralization of the head-turning response. Thus, during the short observation periods utilized, 85 per cent of the infants exhibited head movements restricted to the area to the right of the body midline. Such marked lateralization of response reduces the variability of the head-turning response, by sharply limiting the area in which head turning occurs.

Despite the reduction in the variability of the head-turning response, which reduction occurs as a consequence of lateralization, the results substantiate previous findings of marked variability in the frequency and amplitude of head turning (12). In addition, in our results there is evidence of variability with respect to the left-right sequence of head turning. In part, the overall variability may be accounted for by the relationship between head turning and movements of other parts of the body. Although it is possible to argue, as Gesell and Amatruda have done (3), that it is the head movement that is responsible for the arm movement, recent results obtained by Lesny (6) suggest that head posture is determined, at least in part, by arm movements and even by palmar stimulation. It is likely that there is a reciprocal relationship between head and arm movements, with each affecting the other.

A further portion of the variability in patterning may be accounted for by the finding that spontaneously occurring head movements are related to incidental self-applied facial stimulation, both concomitant with and antecedent to the head-turning response. From our data, it is clear that such facial self-stimulation determines, in part, the frequency of the head-turning response, as well as its direction.

A certain portion of the variability of head turning is explained by reference to the factors just discussed. However, since the magnitude of the correlations are low a considerable amount of variance remains unexplained. It is possible to account for the residual variance in at least two ways. It may be accounted for in terms of stimulus determination or in terms of an innate central-nervous-system patterning of behavior. In either case, the explanation chosen is dependent upon theoretical presuppositions.

Lorenz (7) and Lorenz and Tinbergen (8) have proposed a general theoretical framework in which, in addition to stimulus-directed behaviors (or taxis), they have suggested that there exists a class of patterned behaviors in which the patterning is preformed within the central nervous system. According to that view, behavior occurs independently of stimulation, and patterning is projected from the central-nervous-system organization. Such a view represents a two-factor theory in which behavior is accounted for either in terms of stimulus-directed patterning or central-nervous-system projected patterning.

Prechtl (12), working within this general theoretical framework, has utilized both factors in attempting to interpret his observations of neonatal head turning. Directed head turning is interpreted as being stimulus based, whereas the so-called "side-to-side" movements are treated as representing projected behavior. In support of his contention that side-to-side behavior represents a projected pattern, Prechtl has advanced three arguments: (*a*) that the pattern of head movements is stereotyped, (*b*) that there are occasional instances in which the side-to-side movements appear "without any exteroceptive stimulus" (12, p. 237), and (*c*) that external stimulation of the fifth cranial nerve constitutes *the* adequate releaser of the side-to-side pattern.

In view of our failure to find evidence for a stereotyped pattern of spontaneous head movements, it may be inferred that in those studies in which a stereotyped response pattern has been found some as yet undetected organization of patterned stimulation might have been present. In addition, the relationship between the frequency of head movement and the frequency of arm and leg movement (independent of facial stimulation) makes questionable the view that a specific releaser region exists. On the basis of the data of the current experiment, it is seen that two of the points that substantiate the projectional view of the origin of the neonatal head-turning behavior are questionable. Although our data do not provide any information concerning the third point (i.e., the occurrence of patterned response in the absence of exteroceptive stimulation), neither does previous research. Before such a point can be accepted, it will be necessary to study the head-turning response under much more carefully controlled environmental conditions than any thus far reported.

An attempt at parsimonious explanation prompts us to seek to account for the residual variance of the head-turning pattern in terms of a one-factor stimulus-determination model. In so doing, however, we are faced with the task of identifying additional possible sources of stimulation that could account for the residual variance of the response. In the present study, by conducting the observations of the neonates in a separate and quiet examination room, ambient noise, vibration, and light changes were maintained at a low level but not eliminated. Although, during the observation, systematic changes in the physiological condition of the infants were limited by short observation periods (five minutes), rapid and transient fluctuations in internal state could not be controlled. If any or all of these varied stimuli are capable of affecting head turning, they would account for a further portion of the unexplained variability in the patterns of response. The degree to which such potential sources of stimuli did in fact affect the behavior cannot be determined from our experiment. However, there is no *a priori* reason to argue that they are any less effective in influencing head turning than are tactile and somesthetic stimuli. Available evidence suggests that a closely related response (sucking) is significantly affected by a wide variety of stimuli (2, 5). It seems likely, therefore, that the *single factor* of stimulus determination (encompassing as it does a multiplicity of causes) is entirely capable of accounting for the residual variance of the head-turning pattern.

Because it is possible to account for the observed phenomena on the basis of the single-factor stimulus-determination hypothesis, it seems unnecessary to advance the additional (and largely untestable) hypothesis of patterned behavior that is solely dependent for its character upon features of central-nervous-system organization. It should be clear, however, that neither hypothesis has been subjected to definitive testing.

F. SUMMARY

The principal findings of this analysis were based on five-minute observations of spontaneous head and limb movements in 20 awake three-day-old neonates. Head-turning movements were found to be restricted to the area to the right of the infants' midline in 85 per cent of the subjects. Variability with regard to amplitude, frequency, and sequence was the most characteristic feature of behavior. A portion of this variability was accounted for by the findings of relationships between head and arm movements (rho $= .420$, $p < .05$) and between head movements and spontaneous facial self-contacts (rho $= .466$, $p < .05$). Alternate theoretical explanations that might account for the residual variance were considered.

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A DEVELOPMENTAL STUDY OF WORD DEFINITIONS*

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A. INTRODUCTION

In his book *The Child's Conception of the World* (3), Jean Piaget makes the following observation:

> Binet, as is well known, has shown that if children of 6 to 8 years are asked "what is a fork" or a "mummy" they reply "it is for eating with," or "it is for taking care of us," etc. The universality of the definition in terms of function has been confirmed by all who have checked the value of Binet's and Simon's tests. Yet these definitions, beginning with the words "it is for . . . (c'est pour)" cover the whole face of nature and do not apply only to the objects and persons in the child's immediate vicinity.

One of the general implications of Piaget's theory of the development of cognitive functioning in children is the idea that the transition from one type of definition to the other coincides with the development of levels of thought progressively "higher" than the previous ones. The various developmental stages are qualitatively different; each progressive stage embodies some unique aspect that characterizes it and that makes it distinctive. For example, Piaget discusses the development of "formal operations": i.e., formal logical thought. "The building up of formal operations . . . necessitates a complete reconstruction which seems to transpose concrete groupings to a new level of thought" (3). And further: "Each of the transitions from one of these levels to the next is therefore characterized both by a new coordination and by a differentiation of the systems constituting the unit of the preceding level (3)."

It would follow, therefore, that taken to apply to the way in which children define words, Piaget's theory could state the following: At one level of thought children define words, both familiar and unfamiliar, in terms of function or use. As they progress, however, toward the level of formal operations, their thinking makes a qualitative jump to the new way of defining words: i.e., in terms of some essential characteristic. The process is not a

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gradual trend of slowly learning the essential characteristics of first this word and then that; rather, the implication is that once they are cognitively equipped for higher level definitions children will apply that ability to all words, just as previously they viewed all words in terms of function.

B. PURPOSE

The purpose of this study is to determine whether or not an empirical demonstration of Piaget's general hypotheses can be achieved.

Piaget's argument can be translated into statistical terms. A table of the frequencies with which various percentages of words are defined in terms of use should reveal a large cluster of children defining exclusively by use and a large cluster of children having made the complete change to the more mature type of definitions: i.e., roughly, a bimodal distribution.

It may turn out, however, that many children achieve a percentage of use definitions near the 50 per cent point or in a variety of proportions that show no overwhelming tendency one way or the other. This fact would tend to support an alternative hypothesis: namely, that children *gradually* learn to define words in terms of essence and eventually outgrow the tendency to view their world in terms of use only.

In addition to determining merely the percentage of words that children define in terms of use, other questions are raised. First, Piaget tends to regard his developmental stages in rather universal terms. Consequently, it might follow that the intelligence of any particular subject has no bearing on whether or not he defines words by use and that the only determining factor is the person's state of cognitive development. In both Piaget and Binet (1) the question of the definitional form is not one of intelligence; rather, of maturation.

In this study, it was felt that the possibilities of the influence of intelligence upon the definition of the words could not be overlooked; therefore the tests that the children took were designed to include a means of estimating the *IQ*.

The second question is that of age. Piaget quotes Binet to the effect that until Age 8 children define words in terms of use (3). And Binet sets 9 as the age level at which use definitions no longer predominate (1).

It would be unwise for us to attempt to make final judgments regarding the age at which the definitions that children employ change from use to nonuse. Consequently, even though the percentage of use definitions is demonstrated to change with age, no absolute cutting point is suggested because of the possible differences between populations.

The final question is in regard to the notion of cutting point or, perhaps, "the point of transition" from defining words by function to defining them by some other essential characteristic. It would seem that for each child the point of transition—if there is one—could be determined only by extensive longitudinal studies.

In this study the cross-sectional approach is taken. The purpose is not so much to determine for each child just where, in terms of developmental time, one stage stops and another begins as it is to test the basic proposition that such a discontinuous break exists. Age notwithstanding, if the theory is in accord with the facts, this "leap" or "complete regrouping" should be revealed by the data.

C. METHOD

The sample of subjects consisted of 117 children, ages 4 through 12. These children were drawn from one socioeconomic grouping—the middle to upper-middle class.

A list of 43 words was presented to each child, who was requested to define each word by answering the question "What does z mean?" or "What is an x?" The administration of the words was standardized by the same objective techniques as are used in the administration of the vocabulary portion of any intelligence test.

The selection of words was designed to fulfill, simultaneously, two functions. On the one hand, the lists included the "criterion" words for which the responses were judged as "definitions by use" or "definitions by basic qualities." On the other hand, from the full list of words, an estimate of the verbal *IQ* for each child was obtained. Consequently, the words chosen were the 40 words of the vocabulary portion of the Wechsler Intelligence Scale for Children. According to Wechsler, the vocabulary portion of the verbal test has the highest correlation with the entire verbal test, both at the younger ages (.79) and also at the higher ages (.89). By scoring the vocabulary list according to Wechsler's criteria, an estimate of the individual verbal *IQ* could be determined.

An additional estimate of the *IQ*, from the Goodenough Draw-A-Person Test, was used along with the Wechsler. This addition served as a crosscheck for the possible role of intelligence.

The words that were chosen as criterion words to determine the presence of use or nonuse definitions were chosen upon the basis of several criteria. First, the words were familiar, they appear early in the Wechsler list, and they have been standardized according to familiarity and facility.

Second, all of the criterion words were nouns. Often the form of definition for a verb or adjective, for example, is of the type "It is when . . . ." Classification of this kind of definition is not only unclear but also not within the limits of the theoretical statements of either Piaget or Binet.

Third, all nouns included in the criterion words were tangible. No abstract nouns such as "affliction" were used. The inclusion of such nouns might prejudice the issue or make scoring in terms of use or nonuse unwieldy or vague.

Fourth, some nouns (although tangible and familiar) are characterized exclusively by a single function or use. An umbrella, for example, is defined primarily as a protection against sun, rain, etc. In terms of the definitions that children would be likely to give, umbrella might *always* be viewed as "something that you use to keep dry when it is raining."

Fifth, some nouns that are familiar, tangible, and not recognizable in terms of some specific use were also excluded. These nouns, however, were also capable of being defined either as a noun or a verb—one clear example is "nail," which can be viewed as "a" nail or as "to" nail.

Sixth, inasmuch as there was an insufficient number of words in the Wechsler list to satisfy the criteria just outlined, three additional words were selected from the Stanford-Binet list. These words were chosen from the early portion of the Binet list, which (like the Wechsler) is standardized according to progressive difficulty. The total number of criterion words was 10: bicycle, orange, knife, hat, letter, puddle, cushion, donkey, diamond, and gown. For these 10 words, the responses were scored as use or nonuse.

The list of 10 criterion words is a list of familiar and tangible nouns that can be defined according to some function or in terms of other characteristics. According to Piaget, the child defines all or most of these words in terms either of use or nonuse, depending upon his level of cognitive development.

The scoring of a particular definition of a criterion word for use or nonuse was designed specifically for this study.

Several possibilities for the criteria of use or nonuse were available. One guide was that supplied by Binet, who formulated a distinction as early as 1915. Binet divided definitions into categories of "definitions in terms of use only" and "definitions in terms superior to use" (1).

For Binet, the definition in terms of use only is always of the infinitive form. For example, "bicycle is to ride, orange is to eat," etc. The definition in terms superior to use is of a more mature "state of mind" and is exemplified by "A bicycle is something to ride" or "An orange is something to eat."

Feifel and Lorge (2), in their qualitative analysis of the various kinds of definitions that children give, find one of them to be use (others are synonyms, explanations, demonstrations, etc.). Feifel's use category is explained by the example of "Orange—You eat it" and is similar to Binet's concept.

With one change, Binet's, and Feifel's, criteria of use were employed in this study. The one alteration applies to the precise distinction between the two types of definitions. It was felt that a definition of the type "An orange is to eat" is clearly a definition in terms of use; yet it was also felt that defining orange as "Something you eat" is also a definition in terms of use insofar as the notion of "Something you . . ." is a convenient colloquialism of neutral value. However, if a child responded with "An orange is a fruit you eat," this response was scored as nonuse because the child had recognized *and stated* not only a use but some other essential characteristic.

D. RESULTS

The first and most general finding of the study is that no evidence was found in support of that interpretation of Piaget's theory that views cognitive development in terms of a discreet or discontinuous progression from one level of development to the next. The relevant data are presented in Table 1.

TABLE 1
FREQUENCY DISTRIBUTION OF USE DEFINITIONS

Per cent of use definitions	Frequency	Per cent of use definitions	Frequency
91-100	4	41- 50	19
81- 90	18	31- 40	9
71- 80	12	21- 30	12
61- 70	16	11- 20	10
51- 60	11	0- 10	6

Table 1 shows that the frequency distribution of the percentage of words defined by use in no way resembles the bimodal distribution that would be necessary to support Piaget's hypothesis. Instead of massing near zero per cent and one hundred per cent, essentially a rectangular distribution was obtained, with the central tendency in the middle (40 per cent to 70 per cent) range.

As age increases, the per cent of use definitions tends to decrease: e.g., 4-year-olds define 78 per cent of the words by use; 8-year-olds, 63 per cent; and 12-year-olds, 25 per cent.

The degree of this relationship was determined by a Kendall rank-correlation coefficient, tau, to be — .93, significant at the .001 level. The relationship between age and words defined by use also agrees with Feifel's finding (2). The regression lines are quite similar in shape.

The transition point (50 per cent) for the two types of definitions in this study was between Ages 8 and 9. This fact is in agreement with Binet's postulation.

As the number of words that the child knows increases, the per cent of use definitions decreases. The degree of association was found to be — .81, (using Kendall's tau) and is significant at the .005 level.

Correlations were computed between the Wechsler verbal *IQ* estimate and per cent of use and between the Goodenough *IQ* estimate and per cent of use. In both cases, the correlations (determined by tau) were not significantly different from zero. It may be concluded, therefore, that intelligence plays a small role, if any, in influencing the per cent of words defined by use.

Our final finding was the lack of any significant difference between the means of males and females on any of the variables in the study. In addition, correlations were computed separately for males and females, and no differences were found.

E. Discussion

The major finding of this study is the fact that there is no empirical evidence for a sudden or discontinuous progression in children's definitions of words. In the light of Piaget's theory, this finding has many implications. Piaget's theory of cognitive development implies progressive "qualitative reorganization." The findings of this study challenge that implication. The study supports, rather, the notion that children learn progressively to define their words in a more "mature" and more "essential" way.

This study, of course, covers only a very small range compared to Piaget's theory in general. It may be that with regard to the notions of causality, space, time, nature, etc., children's explanations do follow the pattern that Piaget outlines. Perhaps further studies based on the paradigm of the present one could verify empirically whether or not Piaget is correct.

In a chapter of *The Psychology of Intelligence* (4), entitled "Social factors in intellectual development," Piaget states that ". . . logic [logical thought] requires common rules or nouns; it is a morality of thinking imposed and sanctioned by others." In other words, the way we think and speak is shaped by, directed by, and taught by others. In terms of the present study, Piaget supports the learning notion that has been empirically demonstrated and which is diametrically opposed to the position that the majority of his arguments imply. While it is true that Piaget attempts to present both the "nature" and the "nurture" of cognitive development, Piaget's sympathies seem to lie with the innate view—i.e., with the view that all men necessarily advance toward "operational" or logico-scientific thought, no matter what their environmental situation.

Whatever the repercussions for the theory that the notion of a morality of logic and thought may have, the implications for further research in this area are manifold. For example, one of the limitations of the present study is that it was restricted to middle-class children. The question may be asked, with justification, if it is not possible that the thought and language of middle-class children have been influenced by a particular middle-class "linguistic ethic." What of children who belong to lower classes? It is clear that the latter's social environment imposes different sanctions for grammar than are imposed by any middle-class ethic. Only additional research can determine the extent of this sociocultural force.

Finally, no matter what the form of future research in this and related areas it is clear that account will have to be taken of the interaction of environmental influences as well as natural-growth tendencies. The extent of those influences in a study such as this has not been determined nor was it determined in Piaget's theoretical formulation. However, while the complexity of such a comprehensive analysis is great, its importance is self-evident and fundamental to a full understanding of cognitive development.

F. SUMMARY

A sample of children was studied to determine whether or not Piaget's theoretical position of discontinuous cognitive development is tenable with regard to the way in which children define words. The findings support an alternative conclusion: namely, that the transition from the infantile mode of defining words to the more mature form is gradual and slow. It was also found that intelligence and sex play no important role in this development. Factors that do correlate with the mode of defining are (*a*) age and (*b*) number of words known.

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EARLY OLFACTORY EXPERIENCE AND LATER SOCIAL BEHAVIOR IN THE RAT: PREFERENCE, SEXUAL RESPONSIVENESS, AND CARE OF YOUNG*[1]

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A. INTRODUCTION

Much of the research on the development of the preference for species in mammals has involved manipulation of the early environment. Harlow (7) has reported the importance of early soft-body contact in the development of species preference in the monkey. Igel and Calvin (8) have found that soft-body contact is also important in the development of preference in the young dog. Marr (9) has found evidence for the hypothesis that early association between varying stimulation and a visual pattern results in young puppies learning the characteristics of the pattern.

The characteristics of the species also seem to be learned in presocial birds according to the studies on imprinting. In his review of these studies, Moltz (10) finds that imprinting is a type of early learning that results in the young bird preferring its own species rather than other species. As a result of the bird's association with the stimulus characteristics of the parent while in an aroused state, it comes to approach its own species, to congregate with other members of the species in strange and fearful situations, and to breed with its own species.

The studies on the development of the preference for the species have concerned themselves primarily with the learning of the visual characteristics of the species. But it has been implied that the young organism probably learns to recognize characteristics other than the visual characteristics of the species. Thorpe (12) has suggested that the importance of odor in species recognition is apt to result from olfactory conditioning in infancy. The cluster of normal olfactory characteristics of the species has been found to be an important variable in sexual behavior and the retrieval of young rats (1, 3).

The purpose of this study was to examine the effect of early olfactory ex-

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perience on later social behavior in the albino rat. It was hypothesized that modification of the olfactory characteristics of the mother and litter mates of the young rat results in a modification of later social behavior that is in part determined by olfactory stimuli. The three types of social behavior that were examined for effect of the early olfactory experience were preference when confronted with rats of different odors, sexual behavior, and care of young (as indicated by the emotionality of the young).

B. Method

1. *Subjects*

The *S*s were 45 albino rats of the Wistar strain. Their mothers were placed in 17″ × 10″ × 8″ cages enclosed at the back, top, and three sides. The front and bottom of each cage were wire mesh, and an external food hopper and water bottle were attached to the outside of the front side. The cages rested on a commercial granular-cellulose bedding. The odors were rubbed daily into the coats of the pregnant females in order to acclimate the animals to the odors and the handling. Cages were inspected daily, and the olfactory treatment was discontinued for two days when the young were born.

2. *Early Olfactory Experience*

a. Odors. Besides the normal odor of the control group (N), Yardley's Red Roses cologne was applied to a second group (Y); and a mixture containing methyl salicylate was applied to a third group (MS). The latter consisted of one part of 70 per cent alcohol, one part glycerin, and two parts of 100 per cent methyl salicylate. Methyl salicylate occurs naturally as oil of wintergreen, and the mixture used can be distinguished readily from Yardley's Red Roses cologne. Neither odor produced an avoidance response when placed in front of naive rats. When methyl salicylate is administered orally to lower animals, it produces liver damage, gastric ulceration, and antipyretic effects (5, 6).

b. Infant experience. Each odor was rubbed onto the coats of 15 *S*s and their mothers beginning two days after birth and continuing until 30 days of age. Once a day, a two-inch square white cloth was saturated with the proper odor and *S* was picked up in one hand and rubbed on the dorsal, ventral, and lateral surfaces with two strokes each in the cephalad direction. The treatment for the control group (N) differed only in that the cloth was one that had been in the cage from the onset of the pregnancy of the mother and was not saturated with liquid. The mothers were removed when the young were 21 days of age.

3. *Measurement of Social Behavior*

a. Preference apparatus and testing. A modified Y maze with wire top and bottom was mounted 10 and one-half inches from the floor of a 66″ × 82″ room. The maze was modified, so that each end had a six-inch-long compartment built at right angles to the 24 inch by five and one-half inch arm. The last three inches of those extensions were blocked by a screen (one-half inch wire mesh) to provide a restraining area for the stimulus animals. In each extension was a metallic platform (eight inches by five and three-quarter inches) which rested on microswitches wired to a clock. An 80 gm rat would activate a clock if it stepped on the platform. Food was placed in the compartment of each stimulus animal, and a water bottle was attached to the outer wall of the compartment. One stimulus animal was normal, one was rubbed with Yardley's Red Roses cologne, and one was rubbed with the methyl-salicylate mixture.

Each *S* was tested for 23 hours between 30 and 45 days of age. At the start of testing *S* was placed in the middle of the maze where food and water were located. After each test, the apparatus and room were cleaned and aired.

b. Breeding test. After testing, like-sexed *S*s within a group were housed together in a colony room with normal colony odors present. No odors were applied. From 75 days until breeding tests, *S*s were housed separately in seven by nine and one-half inch cages in a 12-hour day-night cycle. Females were placed in activity cages daily to determine the receptive stage of oestrus. The other criterion of receptivity of female was lordosis during mounting. When the female was receptive, a male was placed in the breeding box for 15 minutes alone prior to the introduction of the female.

The box was 25 inches long, 13 inches wide, and 17 inches deep, and had a one-half inch square wire-mesh floor. The only lighting in the room was from a dark amber bulb located three feet over the box. The measures were the amount of time the male followed the female in the first 20 minutes, the latency to the first mount, and the number of mounts in one hour or until the male had ceased mounting the female for 15 minutes, whichever came first. If no lordosis was observed, even though one mount was observed, the female's activity was recorded daily until heat was again indicated and then was tested again with the same male. Each *S* was tested with another *S* from the same group, but all *S*s were characterized by the natural rat odor.

c. Pregnancy and housing of young until testing. After the breeding test, the breeding pair were housed together for a week in a 12-hour day-night cycle. The male was then removed, and newspaper strips were placed in the female's cage for nesting. Food and water were supplied by external containers. The nesting material was not removed until the young were weaned at 21 days of age, but the wire-mesh bottom was lifted from the tray containing the commercial bedding at 12 days of age and placed in a normal cage rack with the cage bottom suspended three inches over the tray with new bedding. The young were segregated by sex at 30 days.

d. Open-field tests. When 50 days of age, each of the *S*-2s was tested in an open-field box similar to that described by Denenberg (4). The indices of emotionality obtained were the number of squares entered and the number of boluses by each *S*-2 in three minutes.

C. RESULTS

1. *Preference*

Table 1 presents the mean time that each of the three groups spent with each of the stimulus animals during the 23-hour period. The group reared with N mothers spent more time with the N-odor animal than with the other stimulus animals. Also, the group reared with Y mothers spent more time with Y than with other stimulus animals. But the group reared with MS mothers spent more time with N animals than with the other stimulus animals.

TABLE 1
MEAN TIME (IN MINUTES) SPENT BY EACH OF THE DIFFERENT INFANTILE OLFACTORY-EXPERIENCE GROUPS WITH EACH OF THE OLFACTORY-STIMULUS RATS IN A 23-HOUR TEST PERIOD
($N = 45$)

Rearing group	Stimulus animal		
	Normal odor	Yardley's Red Roses	Methyl salicylate
Normal odor	185.83	113.53	135.40
Yardley's Red Roses	65.46	153.86	52.66
Methyl salicylate	203.00	166.66	180.40

An analysis of variance reveals significant rearing effects ($F = 5.73$; $df = 2{,}36$; $p < .01$), significant test-room position of stimulus animals ($F = 5.47$; $df = 2{,}36$; $p < .01$), and significant rearing-preference interaction

($F = 2.75$; $df = 4{,}72$; $p < .05$). Two-tailed t tests of the differences in preference for each group indicate that only the Y group's preference for Y over N and MS was significant ($p < .05$).

The number of *S*s preferring the odor with which they were reared over the other odors was tested for each group, using Friedman's analysis of variance (11), and both Y and N groups were found to prefer Y and N stimulus animals respectively ($p < .001$, $p < .05$).

2. *Breeding*

There were no differences between groups in the amount of time the male followed the female in the first 20 minutes nor were there any differences between groups in the latency to the first mount. The mean number of mounts by group are shown in Table 2.

TABLE 2
NUMBER OF MOUNTS WITH A NORMAL-ODOR ANIMAL FROM THE SAME GROUP IN ONE HOUR OR UNTIL MOUNTING CEASED FOR 15 MINUTES

	Infant experience (females)		
Parameter	Normal odor ($N = 4$)	Yardley's Red Roses ($N = 8$)	Methyl salicylate ($N = 6$)
Mean	37.0	18.0	14.8
SD	9.9	18.1	18.4

An analysis of variance reveals significant breeding effects ($F = 24.29$; $df = 2{,}17$; $p < .01$). The two-tailed t tests of the differences between the N group and the others were significant ($p < .01$).

3. *Emotionality of the Young of the Groups*

Two of Y females did not give birth. One MS animal ate all her young and another ate eight of 11. The activity and bolus scores of the young in the open-field test are shown in Table 3.

TABLE 3
MEAN NUMBER OF SQUARES ENTERED AND MEAN NUMBER OF BOLUSES IN ACTIVITY TEST OF YOUNG REARED BY FEMALES IN THE DIFFERENT GROUPS

	Infant group		
Variable	Normal odor ($N = 40$)	Yardley's Red Roses ($N = 64$)	Methyl salicylate ($N = 53$)
Squares entered	36.2	18.9	41.2
Boluses	1.0	2.3	0.9

An analysis of variance indicates significant differences in activity scores among the young of the groups ($F = 29.5$; $df = 2,11$; $p < .001$). The Y group young were found to be significantly less active than young of the N and MS groups. The other emotionality measure in the activity box, boluses, was also found to be significantly higher for the Y group ($\chi^2 = 13.6$ and 20.4, $df = 2$, $p < .01$).

D. Discussion

The hypothesis that modification of the olfactory characteristics of the mother and littermates of the young rat results in a modification of later social behavior is supported by this study. *S*s reared with mothers of normal odor prefer rats of normal odor, whereas *S*s reared with mothers with Yardley's Red Roses preferred rats smelling of Yardley's. The sexual responsiveness of *S*s reared with mothers of other than the normal odor was significantly less than that of *S*s reared with mothers of normal odor when all *S*s were paired with opposite-sex *S*s of normal odor. The young of the Yardley *S*s were also significantly more emotional, as shown by the low activity scores and high bolus scores than the young of either the normal or methyl-salicylate groups.

The hypothesis does not seem to be supported in preference or care-of-young effects by the methyl-salicylate group. They preferred animals of different odors equally, and their young were no more emotional than those of the normal group. However, this finding must be considered in light of the toxicity of methyl salicylate. The MS group may have ingested some of the methyl salicylate since the MS mothers were carrying it on their coats, as were the litter mates. Possibly the members of the MS group were demonstrating a partial loss of the olfactory sense in all tests, or the young with MS on their coats became avoidance stimuli to their mothers as a result of her licking the young and ingesting some of the MS. The resulting decreased care may have been reflected in the tests.

The finding of decreased sexual responsiveness of both abnormal-odor groups is in accord with previous research by Beach (1). He concluded that visual, olfactory, and cutaneous stimulation offered by a sexually receptive female are conducive to sexual excitement and arousal of the copulatory pattern in the male, but none of these stimuli, by itself, is essential if the copulatory threshold is sufficiently low. All males in this study mounted the females, and there were no differences in the latency to the first mount;

but those reared with abnormal-odor mothers mounted less frequently than those reared with normal-odor mothers. Considering the characteristics of methyl salicylate, the MS group effect may have been due to the members of this group being partially anosmic. But the effect on the Y group was possibly due to an inhibitory response of these *S*s when confronted with an odor other than that which they had associated their species while they were young. If this interpretation is correct, Y *S*s would have mounted Yardley-odor *S*s in another breeding test. Unfortunately, it was impractical to do this further breeding test in this study because of the small size of the female sample within the group.

The differences in emotionality of the young of the groups is also explainable in terms of the MS group having lost at least part of their sense of smell and the Y group inhibiting responses to their odor young. Beach and Jaynes (3) have reported that anosmic females retrieve young as efficiently as do rats with intact olfactory bulbs, but that normal females retrieve rats smelling of Chanel No. 5 only after they retrieve all normal-odor pups. The Y Group females may have inhibited normal-care behavior towards their young with the result that these young were more emotional than those of the normal or anosmic MS groups.

According to Beach (2), species-specific behavior patterns have historical, environmental, and organic determinants. This study gives some supporting evidence that specific social-behavior patterns involved in preference, breeding, and care of the young are partially determined by early olfactory experience in the rat.

E. SUMMARY

The effect of early olfactory experience on later social behavior was investigated in rats. Mothers and young were rubbed daily with cloth smelling of normal odor, cologne, or methyl salicylate. Dependent variables were choice (in a Y maze) among rats smelling of the different odors, sexual responsiveness to a normal-odor rat, and open-field behavior of the young of each group. The cologne group preferred cologne rats, were less responsive sexually to normals, and reared young that were more emotional than those of normal parents. *S*s reared with mothers and litter mates smelling of methyl salicylate (a toxic substance) appeared to be socially anosmic. These results suggest that specific social-behavioral patterns are a function of early olfactory experience in the rat.

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CHANGES IN INTELLECT WITH AGE: V. DIFFERENTIAL CHANGES AS FUNCTIONS OF TIME INTERVAL AND ORIGINAL SCORE*

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BERNARD BERKOWITZ AND RUSSEL F. GREEN

A. INTRODUCTION

Little is known about the differential changes in achievements of older people of diversified intellectual ability between re-examinations after short intervals and long intervals of time. Owens (9), using the Army Alpha, reported on males who averaged age 50 at retest. He claimed "that increments and decrements in test scores from age 20 to age 50 are roughly comparable at all kinds of initial ability." He concluded that age is not kinder to the more gifted. His sample was drawn from a college population and probably represented a restricted sector of the intellectual spectrum. Jarvik, Kallmann, and Falek (7) also reported results based on four Wechsler-Bellevue subtests, on an above-average, aged group. An 11-month and an eight-year retest interval were compared. Only digit-symbol scores showed a differential change. Eisdorfer (5) used subjects past age 60 with a wider intellectual range. He reported that WAIS scores showed little differential change after a three-year interval.

The present study is concerned with the relationship of initial achievement on a Wechsler test to change in achievement on retest. Specifically, the changes in achievement that occur in elderly people when retesting occurs shortly after the initial examination are compared with changes after a longer test-retest interval.

Derner, Aborn, and Canter (3) and Steisel (10) had reported that, for younger adults, retesting after an interval of less than six months produced a significant increase in achievement; therefore, the present authors decided to retest a short-interval sample less than six months after the first examination. A minimum of five years intervened between the original examination and the retest for a long-interval sample.

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* Received in the Editorial Office on April 1, 1965, and given prior publication in accordance with our policy regarding manuscripts on the subject of aging. Copyright, 1965, by The Journal Press.

B. SUBJECTS

All subjects were elderly males, who were residents of a Veterans Administration Domiciliary. The nature of the institution and the demographic composition of the population from which the samples were drawn are given in greater detail elsewhere (1, 2). Whether a subject was tested with Wechsler's Adult Intelligence Scale (WAIS) or with a Wechsler-Bellevue (W-B) was determined by the date of admission to the facility. Until 1958 subjects had been examined with the Wechsler-Bellevue. After 1958 subjects who were given a first examination were given the WAIS. Some of the long-time residents were included in the WAIS (i.e., short-interval) sample because the first testing for them occurred after 1958.

C. PROCEDURE

To evaluate changes in achievement after a short interval the following method was used. An *IQ* range from 60 to 139 was assumed. This range was divided into 16 intervals of five *IQ* points each. The theoretical frequency for each interval for a normal distribution for an *N* of 64 was determined to the nearest whole number.

All members of a Veterans Administration Domiciliary who had been tested with the WAIS less than six months previously and previously had not been given any other Wechsler tests were listed. They were categorized into the 16 intervals based on their Full Scale *IQ*. Twenty-six to 180 days later a sufficient number from each cell that had a sufficient number of candidates were retested with the WAIS to fill the normal-curve quota for each interval and yield a total *N* of 64. There were no candidates for the intervals 120 to 124 and 135 to 139. The interval 85 to 89 lacked one candidate to complete its quota. Subjects were therefore chosen at random from the surplus candidates of adjacent intervals to replace the missing quotas. Random methods were also used for the selection of the candidates from any interval having an excess of candidates in order to complete the quota for that cell. The final distribution of Full Scale *IQ* scores on the first examination was a close approximation to a normal curve.

To evaluate changes in achievement after a relatively long interval, all members of the Domiciliary who had been tested with the Wechsler-Bellevue Form I five or more years previously were listed and retested with the W-B. A detailed description of the group and the procedure is given elsewhere (2). Although no deliberate efforts had been made to control the frequency distribution for this sample, the Full Scale *IQ* scores on the first examination were not significantly deviant from a normal curve.

The 64 subjects in the WAIS sample were divided into two groups based on initial Full Scale *IQ*: the upper half (*IQ* 100 to 130) and the lower half (*IQ* 62 to 99). For the Wechsler-Bellevue sample a high, a middle, and a low group were arranged. The high group (Group I) contained the subjects whose initial Full Scale *IQ* ranged from 110 to 139 inclusive. The low group (Group III) contained the subjects whose initial Full Scale *IQ* ranged from 65 to 89 inclusive. The middle group (Group II) contained the remainder.

In evaluating the changes for the 11 subtests, raw-score units only were considered. The Full Scale *IQ*, Verbal *IQ*, Performance *IQ* and the corresponding weighted scores were computed according to the directions given by Wechsler (13, 14).

D. RESULTS

At the time of the first examination the WAIS (short-interval) sample had a chronological mean age of 61.2 years with a standard deviation of 7.68 years. The retests occurred an average of 104 days later. For the entire WAIS sample [*see* Table 1], the mean Full Scale *IQ* increased 3.05 points to 101.36 on the retest. The difference is significant at the five per cent level of confidence. For the Verbal and Performance *IQ*s and for all three of the weighted scores there were also significant increases from the first examination to the second. There was also a mean increase in raw-score achievement between examinations for all 11 subtests, although only seven of the increases reached an acceptable level of statistical confidence. The fact that four of the subtests did not increase sufficiently to be judged statistically significant should not be ignored, even though the meaning of such a result is not certain. On balance it seems reasonable that certain subtests (such as comprehension, digit span, and possibly vocabulary) should not increase much. On the other hand, all 11 subtests are substantially intercorrelated and all correlate with the total *IQ* scores. The overall trend, therefore, is for significant increases to occur.

Means and standard deviations were obtained from the upper and lower halves of the WAIS sample, and these data are presented in Table 2. It is apparent in Table 2 that both the upper and lower halves had approximately equal increases between examinations in all three *IQ* scores and all three weighted scores. On the 11 subtests, the lower half showed numerically (but in no case reliably) higher increases on six subtests and lower (but non-

TABLE 1

MEANS AND STANDARD DEVIATIONS FOR THE FIRST AND SECOND EXAMINATIONS

Score	WAIS (Mean retest interval: 104 days)					Wechsler-Bellevue (Mean retest interval: 8.65 years)				
	First test		Second test		Difference	First test		Second test		Difference
	Mean	*SD*	Mean	*SD*	(M_2-M_1)	Mean	*SD*	Mean	*SD*	(M_2-M_1)
Full Scale *IQ*	98.31	13.40	101.36	13.72	3.05*	100.72	14.89	97.71	14.52	—3.01*
Verbal *IQ*	99.67	15.06	102.03	15.70	2.36*	100.95	15.05	98.64	14.37	—2.31*
Performance *IQ*	96.57	12.01	100.37	12.26	3.80*	101.73	13.56	100.66	13.51	—1.07*
Full Scale score	88.58	22.78	93.80	23.86	5.22*	76.63	25.28	66.91	25.17	—9.72*
Verbal score	54.70	15.28	57.08	15.99	2.38*	42.08	14.70	37.59	14.48	—4.49*
Performance score	33.88	9.57	36.72	10.27	2.84*	34.55	12.70	29.32	12.65	—5.23*
Comprehension	15.05	4.48	15.33	4.19	.28	9.83	3.77	9.09	3.53	— .74*
Digit span	10.02	2.42	10.27	2.40	.25	9.70	2.44	9.12	2.10	— .58*
Arithmetic	10.42	3.26	11.02	3.73	.60*	6.17	2.92	5.47	3.04	— .70*
Similarities	9.20	6.25	10.55	6.78	1.35*	8.82	5.17	7.32	4.93	—1.50*
Picture arrangement	15.42	5.98	17.42	6.77	2.00*	6.44	3.49	5.52	3.56	— .92*
Picture completion	10.20	4.02	11.23	4.24	1.03*	9.15	2.84	8.67	3.03	— .48*
Block design	23.97	8.97	24.59	8.72	.62	13.32	7.96	10.07	7.40	—3.25*
Object assembly	21.19	7.15	23.80	7.22	2.61*	15.60	4.62	13.58	4.81	—2.02*
Digit symbol	27.62	11.26	29.08	12.29	1.46*	22.22	11.58	17.93	9.82	—4.29*
Information	16.34	5.11	17.09	4.84	.75*	14.13	4.95	13.14	5.41	— .99*
Vocabulary	41.56	15.71	42.52	15.83	.96	21.93	8.35	19.12	8.08	—2.81*

* $p < .05$.

TABLE 2

Mean and Standard Deviations for the First and Second Examinations for the WAIS Sample
(Mean retest interval: 104 days)

Score	Upper half First test Mean	Upper half First test *SD*	Upper half Second test Mean	Upper half Second test *SD*	Upper half Difference	Lower half First test Mean	Lower half First test *SD*	Lower half Second test Mean	Lower half Second test *SD*	Lower half Difference
Full Scale *IQ*	108.72	7.31	111.69	7.82	2.97*	87.91	9.38	91.03	10.07	3.12*
Verbal *IQ*	111.19	9.16	113.50	9.59	2.31*	88.16	10.15	90.56	11.73	2.41*
Performance *IQ*	104.12	6.60	107.84	8.74	3.72*	89.03	11.49	92.91	10.67	3.88*
Full Scale score	105.00	14.63	110.16	16.40	5.16*	72.16	16.83	77.44	18.31	5.28*
Verbal score	65.81	9.81	68.13	10.34	2.31*	43.59	11.11	46.03	12.67	2.44*
Performance score	39.19	7.09	42.03	9.27	2.84*	28.56	8.80	31.41	8.38	2.84*
Comprehension	17.84	3.50	17.84	3.41	.00	12.25	3.52	12.81	3.33	.56
Digit span	11.22	2.12	11.34	2.28	.12	8.81	2.10	9.19	2.02	.38
Arithmetic	12.13	2.67	12.97	2.76	.84*	8.72	2.90	9.06	3.57	.34
Similarities	13.72	4.44	15.56	4.13	1.84*	4.69	4.20	5.53	4.93	.84
Picture arrangement	17.72	5.64	20.28	6.85	2.56**	13.13	5.47	14.56	5.43	1.43**
Picture completion	12.66	3.21	13.25	4.06	.59	7.75	3.18	9.22	3.41	1.47*
Block design	28.31	6.36	28.44	6.97	.13	19.63	9.18	20.75	8.68	1.12
Object assembly	23.03	6.87	25.53	6.61	2.50**	19.34	7.05	22.06	7.48	2.72**
Digit symbol	33.38	10.98	35.13	12.94	1.75	21.88	8.28	23.03	8.02	1.15
Information	19.22	4.09	19.78	3.76	.56	13.47	4.40	14.41	4.31	.94**
Vocabulary	51.41	12.30	52.72	12.14	1.31	31.72	12.25	32.31	12.11	.59

* $p < .01$.
** $p < .05$.

reliably) increases on five. Clearly, this is essentially an even split. It appears, therefore, that unless the score intervals change as one goes across the *IQ* range, the lower and higher halves had similar changes between the two testings. It is worthy of note that, except for the comprehension subtest (on which the upper half showed no net change in mean), all subtest means showed increases—four in each group being statistically reliable.

At the time of the first examination the Wechsler-Bellevue (long-interval) sample had a mean age of 56.33 years. At the time of the retest their mean age was 64.98 years. For the entire Wechsler-Bellevue sample [*see* Table 1] the mean Full Scale *IQ* on re-examination had *decreased* 3.01 points. For the Verbal and Performance *IQ*s, for all weighted scores, and for all mean raw subtest scores there were also significant decreases from the first examination to the second.

The means in *IQ*, weighted scores, and the 11 subtests for each testing and changes between examinations for the three W-B subgroups are presented in Table 3. The 51 subjects with the highest Full Scale *IQ*s on the first examination showed significant decreases in all three *IQ* scores and in all three mean weighted scores. Among the 92 subjects in the central range of *IQ*s, the

TABLE 3

MEAN AND STANDARD DEVIATIONS FOR THE FIRST AND SECOND EXAMINATIONS FOR THE THREE LEVELS OF THE WECHSLER-BELLEVUE SAMPLE

	Level I (*IQ* = 110-139) (*N* = 51)				
	First test		Second test		
Score	Mean	*SD*	Mean	*SD*	Difference
Full Scale *IQ*	118.19	7.34	113.90	8.67	— 4.29*
Verbal *IQ*	118.11	8.51	114.09	9.34	— 4.02*
Performance *IQ*	115.78	8.24	113.56	8.76	— 2.22**
Full Scale score	106.05	13.21	94.11	16.16	—11.94*
Verbal score	58.88	8.16	53.21	9.97	— 5.67*
Performance score	47.15	8.20	40.90	9.21	— 6.25*
Comprehension	13.19	2.34	11.98	2.92	— 1.21*
Digit span	11.68	2.24	10.58	2.04	— 1.10*
Arithmetic	8.88	2.39	8.29	2.95	— .59*
Similarities	14.00	3.92	11.86	4.50	— 2.14*
Picture arrangement	8.98	2.74	8.23	3.26	— .75
Picture completion	11.41	1.84	11.21	2.09	— .20
Block design	20.76	6.29	16.43	7.12	— 4.33*
Object assembly	18.90	3.02	16.45	3.30	— 2.45*
Digit symbol	32.45	9.26	26.01	8.36	— 6.44*
Information	18.82	2.59	18.19	2.85	— .63**
Vocabulary	30.66	4.34	27.70	4.36	— 2.96*

* $p < .01$.
** $p < .05$.

TABLE 3 (*continued*)

	Level II (*IQ* = 90-109) (*N* = 92)				
	First test		Second test		
Score	Mean	*SD*	Mean	*SD*	Difference
Full Scale *IQ*	100.30	5.78	96.90	8.09	— 3.40*
Verbal *IQ*	100.18	7.33	97.96	8.05	— 2.22*
Performance *IQ*	101.55	8.21	100.35	9.69	— 1.20
Full Scale score	75.40	11.58	65.10	15.84	—10.30*
Verbal score	41.10	7.80	36.47	8.83	— 4.63*
Performance score	34.29	8.03	28.63	10.10	— 5.66*
Comprehension	9.79	2.91	9.02	2.77	— .77**
Digit span	9.60	1.77	9.00	1.70	— .60*
Arithmetic	5.95	2.11	5.09	2.19	— .84*
Similarities	8.19	3.75	6.77	3.68	— 1.42*
Picture arrangement	6.48	3.08	5.35	2.96	— 1.13*
Picture completion	9.26	2.04	8.56	2.39	— .70*
Block design	12.76	5.96	9.40	5.85	— 3.36*
Object assembly	15.60	3.75	13.57	4.72	— 2.03*
Digit symbol	21.63	8.94	17.21	7.69	— 4.42*
Information	14.40	3.08	13.19	3.86	— 1.21*
Vocabulary	21.55	5.81	18.61	5.52	— 2.94*

TABLE 3 (*continued*)

	Level III (*IQ* = 65-89) (*N* = 41)				
	First test		Second test		
Score	Mean	*SD*	Mean	*SD*	Difference
Full Scale *IQ*	79.87	6.45	79.46	6.95	— .41
Verbal *IQ*	81.31	7.53	80.92	7.66	— .39
Performance *IQ*	84.70	7.58	85.26	8.79	+ .56
Full Scale score	42.73	11.30	37.09	12.51	— 5.64*
Verbal score	23.29	6.96	20.63	7.37	— 2.66*
Performance score	19.43	7.20	16.46	7.47	— 2.97*
Comprehension	5.73	2.76	5.63	2.49	— .10
Digit span	7.43	1.89	7.56	1.76	+ .13
Arithmetic	3.26	1.92	2.80	1.67	— .46**
Similarities	3.78	3.22	2.90	2.93	— .88**
Picture arrangement	3.17	2.42	2.48	2.44	— .69
Picture completion	6.09	2.70	5.75	2.59	— .34
Block design	5.31	4.92	3.65	3.94	— 1.66**
Object assembly	11.46	4.81	10.02	4.29	— 1.44**
Digit symbol	10.80	7.74	9.48	7.96	— 1.32
Information	7.68	3.46	6.70	3.95	— .98*
Vocabulary	11.92	4.50	9.56	4.33	— 2.36*

mean Full Scale *IQ* and Verbal *IQ* score decreases were significant, but the decrease in mean Performance *IQ* score was not, and all three scaled-score mean decreases were significant.

The 41 subjects with the lowest Full Scale *IQ*s on the first examination showed little change in their three mean *IQ* indices, although their mean weighted scores showed significant decreases between examinations. The decreases for Full Scale *IQ* and Verbal *IQ* of the 41 subjects were not significantly greater than zero. The Performance *IQ* showed a small *increase* from the first examination to the second, but it was not significantly greater than could be expected by chance.

With the exception of the digit-span subtest for the low *IQ* group, the high, middle, and low *IQ* groups showed decreases in mean achievement for every subtest between examinations. For the high *IQ* group the decreases for three subtests did not attain a significant level of confidence. All decreases for the middle group were significant. For the low *IQ* group the changes for six subtests did not attain a significant level of confidence. The positive change for the digit-span subtest in the low *IQ* group was small and not significant.

Since all groups showed decreases, the question that immediately follows is whether or not there are significant differences between the changes of the various subgroups within each of the principal groups. The changes in achievement between tests of one *IQ* level, therefore, were compared with the changes in achievement between tests of each other *IQ* level, by a series of analyses of variance. Ten of 17 of these analyses of variance yield significant *F* ratios; therefore, we compared each of the groups with each of the other groups pair by pair. The results are presented in Table 4. For the sample retested after 8.65 years, Group I did not vary significantly from Group II for any variable. Group III differed significantly from Groups I and II in Full Scale *IQ* changes, weighted Full Scale score changes, Performance score changes, and changes in digit-span, block-design and digit-symbol scores. Group III differed significantly from Group I but not from Group II in Verbal *IQ* and Performance *IQ* score changes, in Verbal weighted-score changes and in comprehension score changes.

For the sample retested after a mean interval of 104 days, there were no significant differences in the amount of change between tests, when the highest half of the group was compared with the lowest half of the group. There were no significant differences in the amount of change between tests (except comprehension) when the top-*IQ* quartile was compared with the lowest-*IQ* quartile.

A final result that is important to this study is implied in Table 1 without being explicitly demonstrated. Since the WAIS and the W-B can be considered to be essentially alternate forms of the same function or set of func-

TABLE 4
"T" VALUES FOR DIFFERENCES IN MEAN CHANGES BETWEEN GROUPS

	Wechsler-Bellevue			WAIS	
Score	Between Group I and Group II	Between Group I and Group III	Between Group II and Group III	Between upper 32 and lower 32	Between top 16 and lowest 16
Full Scale *IQ*	.84	3.43*	2.99*	— .17	— .94
Verbal *IQ*	1.77	3.10*	1.79	— .10	.23
Performance *IQ*	.75	1.99**	1.34	— .12	—1.09
Full Scale score	.92	3.44*	2.80*	— .09	— .80
Verbal score	.97	2.56**	1.91	— .13	.21
Performance score	.49	2.71**	2.35**	.00	—1.22
Comprehension	.92	2.16**	1.27	—1.05	—2.18**
Digit span	1.75	3.30*	2.33**	— .63	.34
Arithmetic	—	—	—	1.19	1.29
Similarities	—	—	—	1.44	1.47
Picture arrangement	—	—	—	.95	— .58
Picture completion	—	—	—	—1.63	—1.79
Block design	1.08	2.39**	2.06**	— .67	—1.07
Object assembly	—	—	—	— .14	—1.43
Digit symbol	1.48	3.37*	2.40**	.51	.77
Information	—	—	—	— .74	— .37
Vocabulary	—	—	—	.70	.38

* $p < .01$.
** $p < .05$.

tions, one can ask whether the change scores for the long-interval group and short-interval group are significantly different from each other. Since each of the two groups showed mean change scores that are significantly different from zero and since the mean changes for the two groups are opposite in sign, the differences between their differences are also significant. This observation is necessarily true for all instances in which the changes are significant for both groups. Some of the differences between differences of the four WAIS (short-interval group) subtests that did not have increases that are significant would also be significant. We have observed, however, that the interrelations between the subtests predisposes sets of results like these to be similar. It is sufficient, therefore, to simply point out that the overall result is that the groups changed significantly in opposite directions.

E. DISCUSSION

The decline in achievement for all *IQ* levels on all variables for the sample examined after a mean interval of 8.65 years might imply that we were dealing with an abnormally deteriorating population. Although the subjects of these samples were chosen at random, if the institutional population from which they were chosen were abnormal, the sample would have been flawed. The possibility of abnormal deterioration among the residents of the domiciliary was explored by the authors in an earlier paper (2). In that study evidence against this possibility was presented. In this study we have further evidence that it does *not* occur. If abnormal deterioration were occurring, then one would not expect the normal improvement of about three *IQ* points from the readministration of an intelligence test within one year to occur. Either such persons should fail to learn (i.e., improve), or such improvement should prove to be transitory. However, after a mean interval of 104 days, a sample drawn from the domiciliary showed a normal improvement of three *IQ* points between the testings. The declines found in the long-interval groups may be considered, therefore, to have been the result of changes that resulted from a much-longer time interval transpiring during the age span within which the long-range expectancy is for scores to decline.

We wish to emphasize that based on the changes we obtained on retesting after an interval of 104 days elderly people (mean age 61.2 years) have been demonstrated to retain a large measure of flexibility. In common with young people they were able to improve their scores on the tests, after only one exposure to the test, and to do so to about the same degree. This improvement was still being maintained after an average interval of over three months. Derner *et al.* (3) and Steisel (11) had reported somewhat larger absolute gains than these in younger subjects whose average *IQ* was in the bright-normal to superior level. Their subjects were relatively young and in the age ranges within which people are likely to make the most rapid gains in achievement. Our subjects were in the age range within which, with relatively short time intervals between tests, decrement rather than increment in achievement has been considered probable.

It is interesting to discover that the lower half of our WAIS group showed approximately the same improvement after 104 days as did the higher half of the group. This suggests that something more than intellectual ability or intellectual potential is important in determining the improvement. Jarvik, Kallman, and Falek (7), who reported a small but nonsignificant increment in achievement of aged twins on three of four W-B subtests after an 11-month interval, explained their results on what they called "test wiseness," which counterbalanced a declining trend. Jackson (6) had demonstrated that test-acclimation experience may be as effective as test practice in improving performance. It seems reasonable to accept the evidence that the experience of being tested enhances the test achievements of elderly subjects retested after a short interval. It is not immediately clear why "test wiseness" does not covary with *IQ* unless it is a complex of emotional factors along with perhaps a simple feeling of familiarity.

After a longer interval of time, the improvement that resulted from test acclimation was either lost or was more than counterbalanced by changes in the aging subjects which disposed them to lower performance. What the subjects retained of their previous achievement abilities was eroded by the changes that occurred with increasing chronological age or with the absence of practicing the tasks involved. All *IQ* levels declined in achievement after a mean interval of 8.65 years. The changes found on retest after a long interval probably were indicative of changes in achievement in older people after an interval of more than five years. Declines in achievement with advancing age were generally in accord with the standardization results reported by Wechsler (13) for the W-B and Doppelt and Wallace (4) for the WAIS, on stratified samples. An evaluation of the relationship of stratified results to longitudinal studies was given by Berkowitz and Green (1).

Subjects with the above-average *IQ*s at the original examination showed the largest absolute declines 8.65 years later. On the basis of absolute amount they declined more than those of average or below-average *IQ*. Eisdorfer (5) had reported that after a three-year interval the changes for above-average *IQ*s were not greater or smaller than those of other intellectual levels. For our samples the size of the changes for the above-average-*IQ* group (110-139) was consistently greater (but not always statistically significant) than the changes found for the subjects of the average-*IQ* group (90-109) and the below-average-*IQ* group (65-89). An acceptable level of statistical significance was more frequently attained between Group III and Group I than between Group III and Group II. In each instance the *lower* the mean *IQ* the *smaller* was the size of decline between examinations.

There is one final result that should be considered. As was noted in Table 4, the high half of the short-interval group did not show reliably different mean changes from those of the lower half. In fact, in Table 2 one can observe that the arithmetic differences favor first one half and then the other as one goes from subtest to subtest or even from Verbal *IQ* to Performance *IQ*. In spite of this, if one compares the standard deviations of the changes exhibited by the two halves of the group, he finds that the higher half had a reliably greater spread of change scores for Full Scale *IQ*, digit span, and picture arrangement. The Full Scale *IQ* change scores of the above-average half were about 40 per cent more variable than those of the lower half. These results are shown in Table 5. Similar results for the long-interval (W-B) group are included for the sake of completeness. However, the W-B group has mean differences due to age-related changes confounded in the standard deviations; so cannot be as clearly interpreted.

TABLE 5
STANDARD DEVIATIONS OF CHANGE SCORES OF DIFFERENT *IQ* RANGES

	WAIS			Wechsler-Bellevue		
Score	*IQ* 100 and above	*IQ* 99 and below	*F*	*IQ* 110-139	*IQ* 65-89	*F*
Full Scale *IQ*	3.72	2.67	1.95**	6.28	3.69	2.87*
Verbal *IQ*	4.14	3.14	1.74	6.06	4.76	1.61
Performance *IQ*	5.66	4.92	1.34	7.72	4.90	2.45*
Comprehension	1.90	2.30	1.46	2.40	2.49	1.08
Digit span	1.95	1.19	2.67*	1.64	1.86	1.30
Arithmetic	1.73	1.57	1.22	1.90	1.36	1.94**
Similarities	2.81	2.67	1.11	3.73	2.64	1.98**
Picture arrangement	5.48	3.29	2.78*	3.52	2.26	2.41*
Picture completion	2.04	2.18	1.14	1.73	1.76	1.04
Block design	5.99	5.68	1.11	6.06	4.06	2.21*
Object assembly	6.54	6.14	1.14	3.06	3.68	1.45
Digit symbol	4.97	4.18	1.41	7.38	6.84	1.16
Information	1.92	2.09	1.19	2.35	2.09	1.26
Vocabulary	4.48	3.61	1.53	3.29	2.56	1.65

* $p < .01$.
** $p < .05$.

The differential variability in Full Scale change scores observed between the upper and lower halves of the short-interval group is similar to results reported by Terman and Merrill (12) in their 1937-standardization data on subjects from 3 to 18 years of age for the Stanford-Binet. They reported that the standard error of measurement was a function of *IQ* level. Our results indicate that this is also likely to be true for the WAIS on an elderly sample averaging 61.2 years of age.

One can ask what implications these results have for the intellectual functioning of elderly people. Decline in our long-interval group was to be expected and it was found. Differential decline between *IQ* levels was to be expected and it was found. However, accumulating evidence has pointed to the likelihood that *IQ increases* are to be expected within the higher levels of *IQ*. This was *not* found.

We feel that our data give greater support to a disuse hypothesis of decline than has been presented in the past. Wechsler scores do not depend heavily on speed or motor coordination. In fact, the speed component in the variance of Wechsler scores is probably not more than five or 10 per cent; hence such factors as reaction time and coordination that are often pointed to probably do not contribute much to decline on this test.

The disuse hypothesis is supported by comparing our long-interval results and short-interval results and by noting that even the high-*IQ* individuals in our long-interval group are, on the average, declining. The short-interval group shows essentially the same improvement from an administration of the test as do young people. This improvement lasts for a substantial period of time. It is finally negated by a very long interval of time. Clearly the decline in WAIS performance is not irreversible within these age levels. It is neither irreversible nor inevitable. It seems probable that the high-*IQ* group declines relatively more than the low-*IQ* group because the environment of a domiciliary is relatively more restricted for them than it is for the low-*IQ* people. After all, they *are* part of the environment of the low-*IQ* people.

It is true that some authors, especially Wechsler (13), have written extensively about a "deterioration" hypothesis. It is often not clear how "deterioration" is to be interpreted. It seems likely that in regard to performance on the WAIS it should be heavily regarded as "disuse deterioration." One can expect that it can be thought of as starting to be inevitable and irreversible sometime between the ages of 65 and 70. The typical don't-hold tests show marked breaks in this region—probably due to the onset of the kinds of deterioration to which Wechsler seems to have reference. It would be interesting to investigate relatively short-term retest effects in the over-70 age levels.

F. SUMMARY AND CONCLUSIONS

It appears that:

1. Elderly people derive approximately the same average benefit in subsequent performance increase from being administered an *IQ* test as do young people.

2. Also in common with young people, there is a tendency for the variability of retest changes in *IQ* scores to be positively correlated with intelligence.

3. The long-term trend for elderly people is for their scores to decline.

4. This long-term decline tends to be greater for individuals with high *IQ* than for those with low *IQ*, at least within the population sampled for this study.

5. The long-term decline occurs during a period in which learning ability for the same tasks is demonstrably not impaired to any significant extent.

6. The long-term decline is probably due to disuse of the skills involved rather than to deterioration in any irreversible sense.

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MENTAL-HEALTH IMPLICATIONS OF AGING IN INDUSTRY*[1]

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A. INTRODUCTION

Aging in industry is not featured, in fact is hardly mentioned, in comprehensive gerontological volumes (1, 2), including those sponsored by the Gerontological Society (5, 7, 25); but some related considerations are presented. For example, Dr. Kleemeier's chapter on "Behavior and the organization of the bodily and the external environment" (5, Chap. 13, pp. 400-451) outlines a broad approach toward aging problems in general. In the same volume is the relevant chapter on "Work and occupational skills" by Ross, McFarland, and O'Doherty (5, Chap. 14, pp. 452-502). Also related are Brozek's article on age and functional efficiency (6), Clay's study on performance in relation to age (9), Karsten's study on "Adjustment to old age in industry" (11), and Welford's study of *Ageing and Human Skill* (26).

The most comprehensive book about *Ageing in Industry* has been published in England (8). Clark and Dunn, its authors, use a completely statistical approach concerned with the survival rates for old age for 32 occupations, as found from the census studies in England. Clark and Dunn's purpose is to survey modern industry from the viewpoint of its oldest operators; that is, they attempt to determine what workers are able to continue in various occupations beyond the midsixties. There is need for studies about age differences in work and life-adjustment attitudes in well-defined settings and need for facts concerned with the social psychology of aging in industry. And the foregoing means interpreting individual differences with full consideration of organizational effectiveness and emotional climate, as emphasized by Argyris (3, 4).

The need for considering emotional climate and setting for understanding

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any given personality is well expressed by D. H. Lawrence in an essay called "We need one another":

> You may imagine you are something very grand, since few individuals even approximate to this independence without falling into deadly egoism and conceit; and emptiness. The real danger is, reduced to your own single merits and cut off from the most vital human contacts, the danger is that you are left just simply next to nothing. Reduce any individual, man or woman, to his elements, or her elements, and what is he? what is she? Extremely little! Take Napoleon, and stick him alone on a miserable island, and what is he?—a peevish, puerile little fellow. Put Mary Stuart in a nasty stone castle of a prison and she becomes merely a catty little person. Now Napoleon was not a peevish, puerile little fellow, even if he became such when isolated on St. Helena. And Mary Queen of Scots was only a catty little person when she was isolated in Fotheringay or some such hole. This grand isolation, this reducing of ourselves to our very elemental selves, is the greatest fraud of all. It is like plucking the peacock naked of all his feathers to try to get at the real bird. When you've plucked the peacock bare, what have you got? Not the peacock, but the naked corpse of a bird (13, p. 479).

B. PURPOSE

The purpose of the present study is to review two series of articles: one concerning work and life-adjustment attitudes; the other, stereotypes of age preferences for happiness (17, 18, 19, 20, 21, 22). And, in the light of these studies, to consider mental-health needs and possible mental-health programs dealing with the problems in industry.

The setting for the studies reviewed involve a history of security and a pattern of management designed to be firm but democratic. The more generalized conclusions are best conceived as applicable to organizations similarly designed and managed.

For the studies on work and life-adjustment attitudes, 257 subjects were divided into four groups as follows: Group I—composed of 103 workers from 19 to 29, Group II—composed of 98 workers from 30 to 44, Group III—43 workers from 45 to 59, and Group IV—13 workers from 60 to 77. All of the subjects were from the parent plant in St. Louis (17). The results were based on the findings of morale-survey data (41 items, 28 of which refer to work attitudes and 13 to life-adjustment attitudes). As a simple expression of the general tendency of an individual toward satisfaction or dissatisfaction, a satisfaction index was used. The procedure for obtaining the index followed that used in determining algedonic differences in the study of individual differences in forgetting pleasant and unpleasant experiences (16). The formula used is $(S \div T) - (U \div T)$. $S =$ responses indicating above-average satisfaction, $U =$ responses indicating below-average satisfaction, and $T =$ the total number of responses. The middle or average choice was not included in the calculations; thus the index is a measure of predominance of satisfaction or dissatisfaction.

For the studies on age preferences for happiness in the various groups, subjects were 270 workers of both sexes working for the same company, though located in three different regions of the United States—Northeast, Midwest, and Far West. The age ranges were 17 to 62 for women and 17 to 64 for men.

C. Review of Studies on Age Differences in Work Attitudes

The findings in the author's first study on age differences in work attitudes may be summarized as follows:

1. There are many statistically significant differences among the four age groups [*see* (17)].
2. In considering the company as a place to work and items indicative of identification with management and their policies, there is a tendency for increasingly favorable attitudes with age.
3. Attitude toward pay becomes increasingly more favorable with age.
4. In most areas tested, satisfaction increases with age.
5. The differentiating age for attitude toward work conditions is 45.

The evidence does not prove Harris's contention that "An old population is more conservative, less creative, less productive, less mobile, and more dependent than the younger one" (10). What the study does show is that the attitude of the older worker can be perceived as a pattern, and that some of the seemingly paradoxical answers obtained make sense in the setting in which they developed. For example, older workers think well of supervisors in general and think that supervisors are interested in them; but they consider themselves neglected in certain types of attention and feel that supervisors play favorites and do not treat them as favorites. When an older worker says he cannot tell how good a job he is doing he merely means that the supervisors take him for granted too much and that he would like more attention. The fact that the oldest group of workers gives the most favorable responses to questions about having had its breaks and share of happiness but rates low in share of recognition makes unifying sense. It makes sense, however, only if the context of the situation and all that characterizes the human-relations practices involved are considered (17).

In a second study of age differences in happiness and life adjustment of workers (20), the author reached the following conclusions:

1. The feeling of the worker that he has had his *share of happiness* increases with age. There are large and statistically significant differences between all groups, with the exception of the two younger groups.
2. The belief of the worker that he has received his *share of happiness* does not seem to differ from age group to age group in terms of statistical significance, but the trend seems to be negatively associated with age.
3. In general *work* takes on more significance with age! *Spare time* decreases in significance with age.
4. With increased age, there is increased interest in *steady work* and decreased interest in advancement. Hope for advancement is low in the youngest group, it decreases with age, and is practically absent in the oldest group.
5. The correlation of *share of happiness* with two items indicative of *self-concept* is relatively consistent, with a coefficient of contingency of .45 for one and .38 for the other. The correlations with two items classified as perception of others are inconsistent: one being the highest, the other being the lowest coefficient of contingency (20, p. 70).

D. A Review of Workers' Perceptual Stereotypes

On the basis of two studies on workers' perceptual stereotypes of age differences (18, 21), particularly in a study of age and sex differences in workers' perceptions of happiness for self and others, differences were found as follows:

1. Perception of happiness in years of life for self and others is different.
2. Perception of years of happiness for others is more consistent, less varied, and a more reliable index of stereotype than perception of years for self.
3. Younger years generally are the more favored years; older years are the least favored in happiness for others.
4. In perception of years of life that are happy for self, personal experience plays a differential role.
5. In perception of years for self, women tend to be more varied and less stereotyped than men.
6. Reasons for selecting happy years of life given by women are different from those given by men and are likely to be in accord with society's notion of male and female roles.

E. Assessing Mental Health in Factory Workers

The most promising study on assessing mental health in factory workers that has come to the attention of the author is that by Kornhauser (12). On the basis of interview responses, Kornhauser developed a mental-health index to reflect anxiety and emotional tension, hostility versus trust in and acceptance of people, sociability and friendship versus withdrawal, self-esteem versus negative self-feelings, personal morale versus anomie or social alienation, and overall satisfaction with life (12, p. 44).

Kornhauser reports a high degree of validity for his index, but he does not reveal his method of scoring. On the basis of the six items listed, highly qualified clinical psychologists and psychiatrists reviewed interview records and gave an overall evaluation of each individual's mental health. Impressions of wives correlated .50 with the mental-health index. Kornhauser reports significant mental-health differences in favor of skilled workers. Fairly consistently, Kornhauser reports poorer mental health in workers on the lower occupational levels. The poorer mental health of the worker, Kornhauser points out, affects not only the industrial behavior of the worker but influences him as a citizen and family community member. Kornhauser insists that his evidence indicates that the differences are not due to differences in education. The proportion of workers having good mental health consistently decreases from the higher levels to the lower levels of occupation.

Kornhauser has advised the author that his system of scoring will be included in a book he is writing. Though I did not use the mental-health index, I did attempt to classify the workers in accord with Riesman, Glazer, and Denney's suggestion in the book *The Lonely Crowd* (23): i.e., into the adjusted, the anomic, and the autonomous. Of 13 elderly people interviewed, none were anomic. Only three could be classified as adjusted in making the easiest adjustment to circumstances without trying to do anything about the circumstances. Ten could be classified as autonomous. This does not mean that 10 out of every 13 people are autonomous, but that in the particular plant at the time of study most of the elderly were doing adequate jobs of interpreting life, as well as living it, and likewise doing a good job. One subject vehemently and four others mildly satisfy Anderson's criterion for living well in old age: "Individuals should try to grow old not passively and gracefully, but actively and ungracefully and should use their learning capacity energetically." (2, p. 541)

From the foregoing, one implication is that the formula that everyone should retire at 65 is ill-advised, if biologic, economic, and social factors are the basis for making a decision (17).

F. Industrial-Health Implications

Considered in terms of morale needs, the studies reviewed imply that there is (*a*) need for replacing stereotypes of age differences with facts about them, (*b*) need for replacing present stereotypes of 40 and above as being old or too old with facts about capacity and attitudes in the light of which opportunities can be provided, and (*c*) need for many to shift their marginal and primary roles as they age.

Theories of activity and disengagement have to be considered specifically for particular people in specific settings. As a general statement, such theories are not relevant in work situations. In work situations there is activity, workers come to do their job, they get paid for it, and know it.

From the point of view of the healthy direction of the aging process it would be more desirable for a complete shift in the differences between what might be called primary roles as against marginal roles. What the right answer would be for any given individual should be differentially considered, depending on human surroundings as well as on skills and abilities, if mental health as a factor in aging is considered primary. One needs to do more than change the attitudes of workers because workers' attitudes are influenced by the attitudes of employers and the management group, who also need to be educated. Knowledge about aging in industry can be used to advantage in more effective personnel management and guidance concerned with the aging process. Manifestations of interest, such as are expressed in the present time, are primarily concerned with problems of the elderly rather than with all workers and with their aging. Appropriate information can also be of value to community sources other than the managerial group because life adjustments include not only work but also activities at home and elsewhere. In the plant studied by the author, because of a history of security with more than 40 years without a layoff, everybody at all ages expressed feelings of security. But even in a plant of the kind studied, one gets the impression that security assures contentment—not necessarily a sense of personality fulfillment. The correlation between share of happiness and security is close to zero.

G. Mental-Health Programs

Based upon the needs discussed in this paper, programs that industry would do well to consider are as follows:

1. Counseling people 40 years and older on the job. Such counseling should be done by people with industrial experience as well as with psychological knowledge and (in the light of the facts presented in this paper) with knowledge of work attitudes, life-adjustment attitudes, perceptual stereotypes, and other knowledge of aging in industry. When a company can afford it and is willing, it would be well for it to start counseling at least 10 years before retirement time to prepare people not only for retirement but for adjustments in later years while still on the job.

2. Changing employment policy about hiring people above 40. This calls for a complete change of attitude on the part of many people responsible for hiring. Companies that have pension programs often think they cannot afford to hire older people because such persons would profit from the pension system without spending many years with the company. Some companies resolve this conflict by getting the older person to forego pension benefits or to agree to an individualized retirement program that does not take money out of the reserves held for those who have worked longer. The problem is more than one of re-educating personnel people to hire people in terms of capacities, abilities, and experience. It involves re-educating top management to the desirability and advantage of hiring older workers. This is not an easy change to bring about, and it calls for national as well as local publicizing of the facts and their significance for hiring. In some instances, one might even find it possible and desirable to do what Marrow did to overcome the resistance to change on the part of the Board of Trustees of his company (15).

Assisted by French, Marrow was able to get the Board of Trustees of The Harwood Company to change their stereotype that older women are inferior to younger women. French and Marrow found that getting facts to management did not change attitudes very much, but when top management was caused to be involved in research, so that the facts would be top management's own discovery, attitudes changed. The factors studied were production, turnover, absenteeism, and speed of learning. After several months of fact finding, the results showed that older women not only equalled but surpassed younger women in production as well as in other factors. The executive-staff members who participated were excited and pleased with having participated in the investigation and did everything they could to have everybody informed.

3. Planned change for the acceptance of change. This concept implies informing workers as well as management. In this connection, it is well for one to keep in mind the words of Lippitt, Watson, and Westley:

> We need always to remember that when examined closely, all dynamic systems reveal a continuous process of change—adaptation, adjustment, reorganization. This is what we mean by dynamic, by being alive. We call these processes learning, development, maturation and growth. But it is equally true, as we can learn both from experience and from the results of scientific studies, that all these systems exhibit a high degree of stability, constancy, or rigidity, in many aspects of their operation and organization. Often as external observers, we can note that this stability is very uncomfortable or even dangerous, not only for the system in question but for its neighboring systems. In other words, the natural dynamic processes of change do not occur fast enough to keep pace with the very rapidly changing conditions of our world today (14, p. 10).

4. Organized labor-management mental-health programs. At the 1964 meeting of the American Orthopsychiatric Association held in Chicago, three labor-management mental-health programs were discussed. Dr. L. L. Tureen presented a program in use for 18 years by the Labor Health Institute operated by the Teamsters Union in St. Louis. Although it is a pioneer effort, in the sense of being one of the earliest to include psychiatric services in the health program, it is far from being an adequate mental-health program. Service is composed of 30-minute sessions, with the average person coming about 10 sessions. Each of three psychiatrists serves 20 hours per week. There is no psychological service. The other unions in town do not participate and do not want to.

The second program presented is one operated by the Amalgamated Clothing Workers of America. The person reporting was Dr. H. J. Weiner, director of the Sidney Hillman Health Center. Dr. Weiner, a sociologist, is directing the agency to be community conscious and is definitely making an attempt to pitch services to community rather than union control.

The third program and the one most relevant for our purpose is one that is concerned not only with labor and management viewpoints but also with public interest. This program was presented by Dr. Peter Senn, economist at Roosevelt University in Chicago. In the program described by Dr. Senn, there are six unions as well as management groups. Unlike other programs, this one makes more conscious use of subprofessional help and reports favorable results and has a research and development division. The total program is divided into administration, clinic, evaluation and research, physician education, and labor education. Dr. Senn emphasizes the public interest because, as he argues, there is little likelihood that private or even state and local financial resources will be adequate for rapidly mounting a massive attack on the problems of mental illness for all those who require care. He argues that:

> Possibly the dominant ideologies, both past and present, of labor, management and the public are outmoded and incapable of dealing with these more complex problems of mental illness. Their ideologies are based on the past and therefore, are for modern problems, bound to be deficient (24, p. 3). In conclusion it cannot be overstressed that whatever knowledge we have of mental health has been paid for by suffering. This knowledge, however valuable and however limited, is held in trust by those using it, but the longer we wait to rapidly extend its uses, the longer will the pain have been in vain. (24, p. 29)

H. SUMMARY

Facts concerning the social psychology of aging in industry, based on two series of studies, serve as a frame of reference for considering mental-health implications in this study. One series is concerned with the work and life adjustments of 257 workers in one well-defined setting divided into four age groups. The second series is concerned with workers' perceptual stereotypes of age differences by the ratings of age preferences for self and others by 270 employees (180 men, 90 women) from three different regions of the United States.

The findings from the work-attitude and life-adjustment studies reported in two articles (17, 20) are summarized in this study. In general, the results indicate many statistically significant differences among the four age groups. In most areas tested, satisfaction increases with age. Increasingly favorable attitudes with age are found in items such as the company as a place to work and related items indicative of identification with management and their policies including attitudes toward pay. The differentiating age for attitudes toward work conditions is 45. In the study of reactions of life adjustments in this group, there is increased interest expressed in steady work and decreased interest in advancement. Also, the feeling about work takes on more significance with age, and spare time decreases in significance with age. Emphasized in these studies are the importance of the emotional climate of an organization and its organizational effectiveness as related to attitudes expressed.

The findings concerning workers' perceptual stereotypes of age preferences are presented in detail in References 18, 19, and 21. The more general finding is that the assumption made in previous studies that one's own impressions of happy years is a reliable measure of stereotype is fallacious; the perception of years of happiness for others is more consistent, less varied, and a more reliable index of stereotype than perception of years for self. In perception of happiness, younger years are generally favored; older years are the least favored.

But in perception of years of life that are happy for self, personal experience plays a differential role. In perception of happiness for self, women tend to be more varied and less stereotyped than men. The reasons given for preferences expressed are in accord with society's notions of the male and female roles.

Needed for improved mental health of all the workers are social acceptance of facts about them, a need for replacing stereotypes of age with facts about them, need for planned change of activity and disengagement in line with realities in a given situation. For organizing this, a change of attitude of employers is even more important than the change of attitude in the employees. Programs considered for satisfying needs discussed in this study are (*a*) Counseling people 40 years old or older while still on the job; (*b*) changing employment policies of not hiring people over 40; (*c*) planned change for acceptance of change; and (*d*) organizing labor-management mental-health programs that provide relevant and adaptive services, particularly for people who are not reared by middle-class values.

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THE REINFORCING EFFECTS OF VARIABLE VISUAL STIMULATION*[1]

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A. INTRODUCTION

Because of the lack of necessary dependence of light-reinforced behavior upon traditional deprivation operations and their derivatives (9, 24), many investigators view the crucial reinforcing event as stimulus change and, as such, cast light reinforcement into the same class as exploratory behavior (5). The stimulus-change hypothesis, however, as an adequate theoretical characterization of the light-onset data possesses a number of shortcomings. Chief among these is the rather general failure of light termination—also a stimulus change—to constitute an equally potent reinforcing operation (3, 8, 25, 26). In those instances in which termination has been found reinforcing, the phenomenon may be confined to dark-reared albino rats (24) or to stimulus intensities (4) at which other investigators have reported aversion (12). As an alternative hypothesis, Lockard (13) has proposed that albino rats have a preference for low-level illumination with rearing luminance acting as a parameter to generate a family of preference functions. As the preference hypothesis accounts more parsimoniously than do other hypotheses for a wide range of the phenomena reported in light-reinforcement literature, the role of stimulus change—if any—remains largely undocumented.

In the present experiments, the possible reinforcing effects of stimulus variation are examined under conditions in which the amount of visual reinforcement per response is held constant. In all treatment conditions, the bar-pressing response is continuously reinforced by light onset; but variability occurs with respect to the position of the light source within the test chamber. As used here, stimulus variability includes two logically independent properties of stimulation: stimulus change and stimulus uncertainty. Stimulus change is

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defined as a condition in which the stimulus consequences of the *n*th response are discriminably different from those of the *n*th — 1 response. Stimulus uncertainty is defined as a condition in which the stimulus consequences of the *n*th response are stochastically independent of the *n*th — 1 response. Given the validity of the preference hypothesis, the present analysis of sensory variation is formally analogous to the more comprehensive research area of varied reinforcement with traditional reinforcing agents (10).

B. Experiment I

1. *Method*

a. Subjects. Thirty-two hooded rats (Long-Evans strain, Rockland Farms), 110-120 days old, and of both sexes, were used as experimental animals. *S*s were reared under a light-dark cycle by the supplier and were maintained on this schedule from seven to 15 days in the laboratory prior to the experiment. Throughout the study, *S*s had free access to food (Purina lab chow) and water.

b. Apparatus. During the course of the experiment, *S*s were housed in an isolation box or a standard operant-conditioning chamber. The isolation boxes were constructed of plywood and were lined with acoustic tile. Each box contained two living cages (Hoeltge HB-34) separated from each other by a cardboard partition. The conditioning chambers (Gerbrands Model C) were inside modified ice-chest hulls. A drinking tube and a hardware-cloth basket containing lab chow were located at one end of each conditioning chamber. At the other end of the chamber, four panel lights with one-half inch white jewels were placed symmetrically about a Gerbrands response bar. The luminance of each lamp was 17.2 mL at the source and 2.15 mL in the vicinity of the bar. The lamps were positioned in the corners of a three-by-five and three-quarter inch rectangle, with the center of the bar at the intersection of the diagonals. The response bar was mounted in the middle of the wall and two inches above the chamber floor. The isolation boxes and the conditioning chambers were light tight and sound deadened with a blower to provide ventilation and a constant masking noise. Two isolation boxes and four conditioning chambers were used—with each box and chamber being represented equally often in each of the treatment conditions. The control of experimental events and the monitoring of responses were accomplished by means of programming and recording equipment located in an adjacent room.

c. Procedure. Prior to the investigations reported here, a number of preliminary studies were undertaken. From the outset, it was felt that a

15-to-30-minute session length (as had been employed in most of the previous research) would be inadequate because of the relatively small number of responses emitted and because of the lack of control over extraexperimental sources of stimulus variation. Accordingly, initial work employed sessions of 24 hours' duration. Four animals given three free-operant sessions and four light-reinforcement sessions in which a single invariant light position was illuminated for the duration of a bar press emitted 92 per cent of their responses in the period between 5 p.m. and 10 a.m. This finding is consistent with other research (4). For all further work, a 17-hour test period between the hours indicated was used. For the remaining seven hours of each day, the animals were confined to isolation boxes because the data from four additional animals indicated that the response rate was markedly depressed if the non-test time were spent in the home cage under daylight levels of illumination.

Four animals were then given six free-operant sessions followed by 15 conditioning sessions to determine the time required for the attainment of stable responding. Three free-operant sessions and six conditioning sessions were found to be sufficient with the present method.

To assess the relative reinforcing effects of the four light positions, eight animals were tested with three free-operant sessions and four conditioning sessions. All animals received light onset from each of the four stimulus positions with the experimental plan consisting of a four-by-four random Latin square. The columns of the square corresponded to conditioning sessions; the rows, to sequences of light positions; and the Latin letters, to light positions. Light position was found *not* to constitute a significant effect ($F = 0.72$; $df = 3, 12$; $p > .20$) nor were any of the three orthogonal contrasts within light positions reliable (horizontal displacement, vertical displacement, and the horizontal-by-vertical interaction). These data will be examined later in another connection.

On the basis of information gained from the preliminary studies, the main experiment employed three free-operant sessions and six conditioning sessions, each session being of 17 hours' duration. Eight animals were randomly assigned to each of the three treatment groups. In all groups, depression of the bar produced light onset for the duration of the response. The nature of the treatments during conditioning were as follows.

(1). *Constant stimulation from a single light position (SP Group).* For a given animal, each response produced light onset from a single, invariant light position. Two animals were assigned to each of the four light positions. The SP Condition, which is the standard light-reinforcement situation, furnished a baseline against which the effects of stimulus variation could be compared.

(2). *Stimulus change from alternating light positions (AP Group).* Within a session, each response led to light onset from one of two light positions in alternating fashion. For a given animal, the two positions remained constant across conditioning sessions, but different animals were randomly assigned to different stimulus pairs.

(3). *Stimulus uncertainty for random light positions (RP Group).* Within a session, each response led to light onset from one of two random, equiprobable light positions. Animals in the RP Group were assigned to the same stimulus-position pairs as the AP animals. It should be noted that the behavior of the RP Group is not solely a function of stimulus uncertainty as stimulus change occurs with probability $p = 0.5$. Such a partial confounding is unavoidable with the use of only two light positions per animal and a single photic pulse per response.

As an aid in interpreting the findings from the three groups described, the behavior of those eight animals previously used to assess the relative reinforcing effects of the four light positions was again considered. This group, each animal of which received light onset from only one stimulus within a session—but from four different positions in the course of four conditioning sessions (DP Group)—furnished data on the effects of a between-sessions stimulus change.

2. *Results and Discussion*

a. Free-operant behavior. Before examining the effects of the experimental treatments, it was necessary to determine if the free-operant performances of the various groups (SP, AP, RP, and DP) were similar. No difference among treatment groups was found ($F = 0.74$; $df = 3, 28$; $p > .20$). The mean number of responses averaged over groups is presented in Figure 1. Over sessions, however, responding decreased ($F = 13.83$; $df = 2, 56$; $p < .001$), with the only significant adjacent difference occurring between the first and second session ($p < .001$). The shape of the group curve is representative of the behavior of individual animals. The decline in the rate of emission of the unconditioned bar press is in agreement with previous work with the albino rat (28) and the mouse (11).

b. Conditioning behavior. An analysis of variance of the performance of all four treatment groups was precluded by the extreme variability between

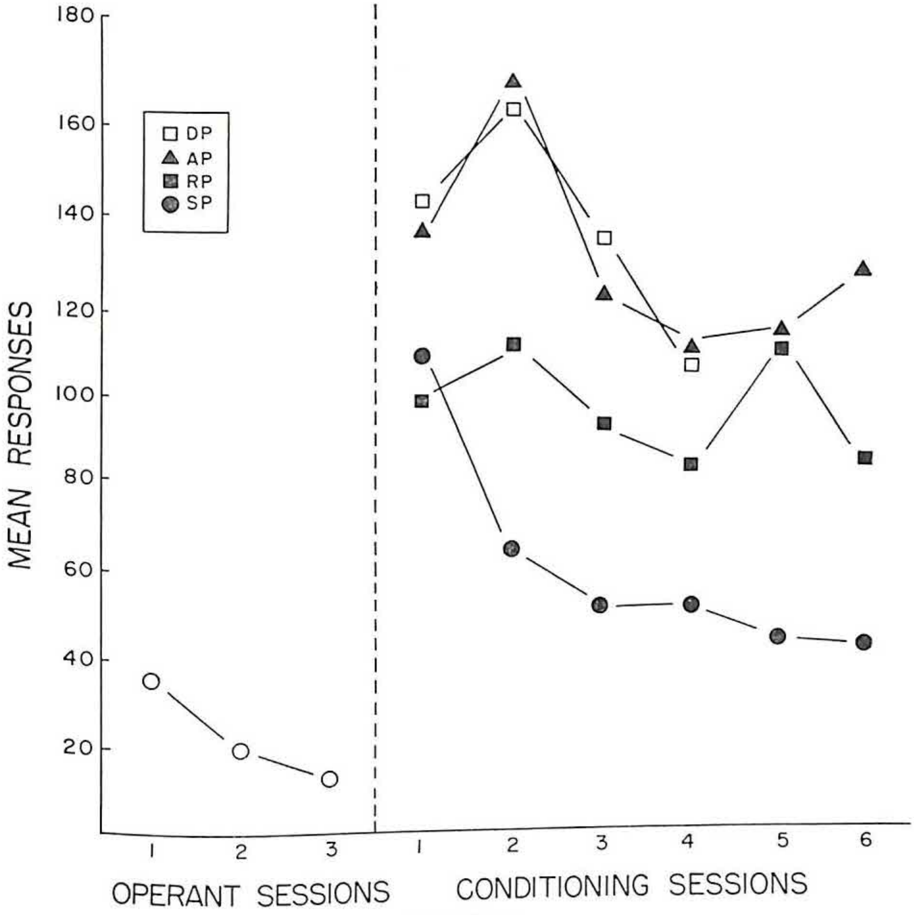

FIGURE 1
THE NUMBER OF RESPONSES EMITTED DURING OPERANT AND CONDITIONING SESSIONS BY THE SINGLE POSITION (SP), ALTERNATING POSITION (AP), RANDOM POSITION (RP), AND DIFFERENT POSITION (DP) GROUPS

animals within the RP Group—the variance being greater by a factor of 18 than that of the next most variable group. Accordingly, Wilcoxon matched-pairs signed-ranks tests were used for all comparisons involving the RP Group.

As shown in Figure 1, the level of responding was appreciably elevated in all groups when bar pressing produced light onset. As measured by the difference between the first conditioning session and the third free-operant session, response frequency significantly increased for all groups ($p < .01$)

except RP ($p < .10$). Moreover, responding remained elevated throughout the conditioning sessions as reflected by the difference between the sixth conditioning session and the third free-operant session. After 102 hours of response-contingent visual stimulation (68 hours in the case of the DP Group), all groups were significantly above the free-operant baseline ($p < .01$).

While evidence for a persistent increment in responding was obtained, the various groups did not display the effect equally (see Figure 1). The SP, AP, and DP groups differed significantly ($F = 7.57$; $df = 2, 21$; $p < .005$) over the first four conditioning sessions, and the SP and AP groups differed over all six sessions ($F = 8.46$; $df = 1, 14$; $p < .02$).[2] Both the AP and DP groups made significantly more responses than the SP Group ($p < .01$). The RP Group did not differ reliably from any other treatment condition. Unlike the free-operant mean-response curve, the conditioning curves—with the exception of that for the SP Group—were not representative of the behavior of single animals. The nonsignificant increase in responding from the first to the second conditioning sessions in the AP and DP groups reflects the fact that 10 of the 16 animals did not respond maximally until the second session. The trend of the RP means is particularly misleading. Two animals in the RP Group failed to condition altogether, and one additional animal did not show an increase in bar pressing until the fourth session. Paradoxically, three animals in the RP Group responded more frequently than did all animals in any other treatment group. To assist in determining whether such variability was simply a function of individual differences or, rather, a consequence of random stimulation *per se,* four more animals were run in the RP Condition. One of these animals also failed to condition.

It appears that stimulus change, whether it occurs between sessions (AP Group) or within sessions (DP Group), leads to an increase in responding greater than that occurring with constant stimulation (SP Group); whereas stimulus uncertainty (RP Group) produces as its major effect an increase in interanimal variability. Some precedent for the variability of behavior when the reinforcing agent is random in its location is available. Havelka (7), using both a T Maze and alleyway task, arranged for two goal areas each of which was divided into four subareas by means of partitions. Food was available in an invariant subarea of one goal and in a randomly determined subarea of the other goal. When hooded rats were given a series of free choices in each apparatus, approximately one-third of them regularly went to the constant goal and one-third to the random goal. Considered together with the results from the present study, the inference is that a consistent individual response to uncertainty in the locus of reinforcing stimulation is manifested by the hooded rat. While the data from the T Maze may have been contaminated by the factor of position habit, the alleyway and the barpressing situations appear to be free of similar biasing factors.

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[2] The preceding analyses are based upon the number of responses in each conditioning session uncorrected for the frequency of free-operant responding. The free-operant rate was found neither to correlate with conditioning rate nor to reduce interanimal variability when subtracted from conditioned responding.

The most consistent feature of the present data is, however, the increased response frequency occurring with stimulus change. As the amount of visual reinforcement per response was the same in all groups, the preference hypothesis does not account for the finding. One other investigation using a stimulus-change condition very similar to the AP Treatment employed here has been conducted by Morris, Crowder, and Crowder (19). Negative results were obtained in that stimulus alternation did not elevate extinction responding above constant stimulation. The session lengths in this study were extremely brief—one 10-minute free-operant session, one conditioning session to a criterion of 10 reinforcements, and one 20-minute extinction session. Furthermore, the general method has led to findings that are not in accord with other work employing longer test sessions; e.g., Morris *et al.* (19) found no effect of stimulus intensity, which finding is inconsistent with that of Lockard (12, 13), and of Nash and Crowder (20), who found no resistance to extinction following light-onset reinforcement, a finding that is inconsistent with that of Barnes and Baron (2).

The finding that the AP and DP stimulating conditions led to an equal elevation in responding is not capable of unequivocal interpretation within the confines of the present experiment. The difficulty arises from the fact that the DP Group, which was intended primarily to provide information with respect to the relative reinforcing properties of the four light positions, received stimulation from all four stimulus positions; while a single animal in the AP Group was exposed only to two light positions. Thus, an evaluation of the effects of between-sessions and within-sessions stimulus change is partially confounded with differences in the number of stimulus positions. Nevertheless, the data indicate that a decreased within-sessions stimulus change may be compensated for by an increase in the number of stimulus positions (an interpretation that suggests that the pattern of test-chamber stimuli to which the animal exposes itself during light onset may play some role in light-reinforced behavior). A similar statement has been made earlier by Robinson (27), but support has been mixed from investigations employing a procedure with short test sessions (1, 23).

The last feature of the data which needs comment is the frequnecy of responding across conditioning sessions. No significant effects of sessions were observed for either the first four sessions ($F = 1.37$; $df = 3, 63$; $p > .20$) or for all six sessions ($F = 1.39$; $df = 5, 70$; $p > .20$). When the various groups were considered separately, a procedure that tends to inflate Type I error, only the SP Group demonstrated a significant decrease in responding ($F = 2.94$; $df = 5, 30$; $p < .05$). The finding that response frequency underwent little systematic change as a function of sessions, together with evidence that responding during the last conditioning session exceeded the free-operant level, indicates that the reinforcing effect of light onset remained at an appreciable magnitude with the present test procedure. Using the more commonly employed short test session, both increases (6) and decreases (29) in responding as a function of time have been reported, with the latter tending to predominate. An examination of some of the variables controlling the course of responding was one of the objectives of the second experiment.

C. Experiment II

The primary purpose of Experiment II was to assess the reproducibility of the central findings of the earlier study: namely, the elevated responding produced by stimulus change (AP Condition) and the increased interanimal variability produced by stimulus uncertainty (RP Condition). In an effort to reduce interanimal and intraanimal variability, free-operant sessions were omitted, thereby assuring an appreciable frequency of responding during the first conditioning session. This modification also permitted an examination of the effects on the time course of responding of two variables: (*a*) the adaptation of the unconditioned bar press, and (*b*) the effects of increasing light deprivation on conditioned responding. With regard to the latter variable, light-reinforced bar pressing has been shown to increase in frequency as a function of light deprivation (21). Assuming that the opposing effects of adaptation (A) and deprivation (D) are independent, their combined action on the slope of the conditioning curve $R = f(t)$ reflects the relative absolute magnitudes of dR_A/dt and dR_D/dt.

1. *Method*

a. Subjects. Twenty-four hooded rats (of the same description as Experiment I) were used. Because of previous difficulties in securing sufficient numbers of animals, a different supplier (Harlan Industries) furnished all *S*s.

b. Apparatus. The same conditioning chambers and isolation boxes were employed in Experiment II as were employed in Experiment I.

c. Method. The animals were randomly subdivided into three groups of eight and assigned to the SP, AP, and RP conditions as earlier defined. The pairs of light positions to which the AP and RP animals were exposed were the same within each group, but were independently determined for Experiment II. In all respects, the procedure was identical to that of Experiment I with the sole exception that conditioning began when the animals were first removed from the home cages and placed in the conditioning chambers at 5 p.m. Thereafter, a 17-hour test session alternated with a seven-hour isolation period until six conditioning sessions had been completed.

2. *Results and Discussion*

a. Variability. Although the omission of free-operant sessions reduced interanimal variability in all groups, behavior in the RP Condition remained more variable than that of the next most variable group by a factor of seven. Once again, both the highest and lowest frequencies of responding were observed in animals in the RP Condition. Experiments I and II, therefore, were consistent in indicating that the salient feature of the response of the hooded rat to stimulus uncertainty is increased interanimal variability.

b. Treatment effects. The mean number of responses for the SP, AP, and RP conditions within each of the six conditioning sessions is presented in Figure 2. Comparisons involving the SP and AP groups were made by analysis of variance while, because of heterogeneity of variance, comparisons involving the RP Group were effected by nonparametric procedures.

In confirmation of the results of Experiment I, the response frequency under the AP Condition exceeded that of the SP Condition ($F = 8.09$; $df = 1, 14$; $p < .02$). The AP mean frequency was greater than that for the SP group during all sessions, the difference being reliable for each of the first three sessions ($p < .025$) and unreliable thereafter. While, in Experiment II, terminal convergence of the conditioning curves was not obtained with the same number of conditioning sessions as in Experiment I and did not give rise to a significant groups-by-sessions interaction ($F = 0.70$; $df = 5, 70$; $p > .20$), future work should employ extended test sessions to assess the range of stable SP-AP differences. A comparison of the RP Group with the SP and AP groups indicated that the RP-AP difference was marginally reliable (Wilcoxon's matched-pairs signed-ranks test, $p < .05$). The wide range of response frequency found within the RP Group

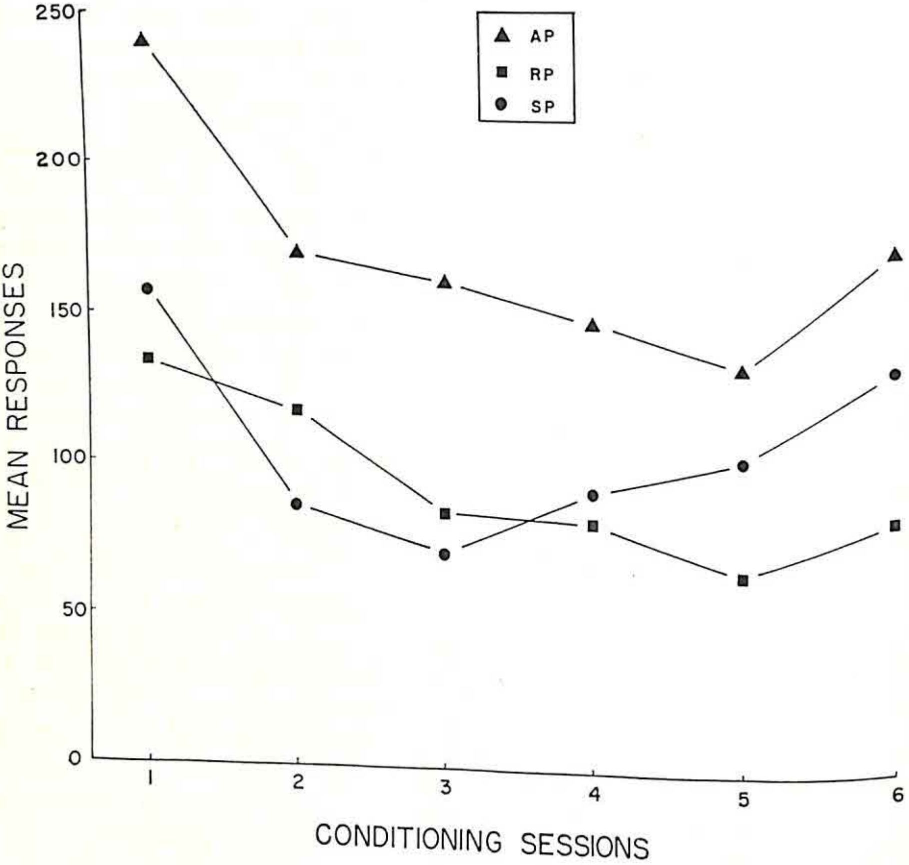

FIGURE 2
THE NUMBER OF RESPONSES EMITTED DURING CONDITIONING SESSIONS BY THE SINGLE POSITION (SP), ALTERNATING POSITION (AP), AND RANDOM POSITION (RP) GROUPS

in both experiments renders the straightforward interpretation of group effects rather misleading, however.

c. Trend over sessions. Unlike the case for Experiment I, the form of the group functions presented in Figure 2 is adequately representative of the behavior of individual animals. The frequency of responding varied significantly as a function of conditioning sessions for the SP and AP groups ($F = 4.35$; $df = 5, 70$; $p < .005$) and for the RP Group (Friedman's test, $\chi^2 = 12.74$; $df = 5$; $p < .05$). For all groups, the change took the form of an initial monotonic decrease followed by a terminal increase in response frequency, the increase being most pronounced in the SP Group. When the session variance of the SP and AP groups was partitioned by means of orthogonal polynomials, the linear component was unreliable ($F = 1.72$; $df = 1, 14$; $p < .20$), but the quadratic component was highly significant ($F = 10.18$; $df = 1, 14$; $p < .01$). In the RP Group, the number of responses emitted during Session 6 was significantly greater than during Session 5 (Wilcoxon's matched-pairs signed-ranks test, $p < .05$). The data from all groups, therefore, are compatible with a simple noninteractive model in which the initial decline may be identified with the previously observed adaptation of the unconditioned bar-pressing response and the terminal increase, with a deprivation effect having a relatively slow growth rate. As noted earlier, the light-reinforcement literature is mixed with respect to the slope of conditioning functions across time. The present study indicates that the state of adaptation of the unconditioned bar-pressing response exerts an influence on the temporal course of light-reinforced responding, and that differences between investigations with respect to this variable are in part responsible for the discrepant findings (14).

D. CONCLUSIONS

Experiments I and II support at acceptable levels of statistical significance the following statements: (*a*) response-contingent light onset that alternates in the position of its source within the test chamber (AP Condition) produces a higher frequency of responding than light onset that is constant in the position of its source (SP Condition), and (*b*) response-contingent light onset that varies randomly in the position of its source (RP Condition) produces a greater interanimal variability than that found in any other condition. The former result has been described as a stimulus change effect; the latter, as a stimulus uncertainty effect (in keeping with definitions given earlier). It should be noted that these findings do not require that either stimulus change or uncertainty are alone sufficient conditions for the production of the effects. Rather, the prior reinforcing status of light onset may be a necessary precondition for their occurrence, and it is in this sense that the present findings may be viewed as instances of varied reinforcement.

Unfortunately for present purposes, the bulk of research in varied reinforcement has been devoted to manipulation of the delay (22) or magnitude (30) of reinforcement and not to variations in the goal response. However, those few studies in which the responses prior to the goal response have been varied (17, 18) have uniformly reported an increase in response strength over constant reinforcement, as measured by a heightened resistance to extinction. Studies directly concerned with the effects of varied goal responses to traditional reinforcing agents are underway in this laboratory as a means of determining whether the present results are more than superficially related to varied reinforcement phenomena in general. Theoretically, the most comprehensive account of varied reinforcement has been provided by the micromolar approach (15, 16). Briefly, the position is that performance will be facilitated by varied reinforcement to the extent that the fractional antedating goal responses (r_g) associated with the various reinforcing conditions summate to increase incentive motivation (K). To the extent that the various r_g's compete, performance will be depressed. If different goal responses are assumed to be associated with different stimulus positions, the present results are contrary to the expectations from micromolar theory. Observations of individual animals by this investigator, as well as others (8), indicate that a wide range of behaviors follow light onset. On occasion the eye will be pressed against the light source while, more commonly, the test environment will be visually scanned. The goal responses associated with the various light positions, therefore, appear to be clearly different.

E. Summary

Two experiments were performed in which the relative reinforcing effects of response-contingent light onset from a variable position within the test chamber and from an invariant position were compared. Using 30 hooded rat *S*s in a free-responding situation, light onset that alternated in the position of its source was more reinforcing than stimulation from an invariant light position. When the source of light onset varied randomly in position it produced large interanimal differences in the rate of responding as its main effect. The former result was described as a stimulus change effect in which stimulus change is measured by the probability with which the *n*th stimulation differed from the *n*th — 1 stimulation. The latter result was described as a stimulus uncertainty effect in which stimulus uncertainty is measured by the degree to which the *n*th stimulation was independent of the *n*th — 1 stimulation. These findings were replicated in a second experiment with 24 animals, with the additional result that both the state of adaptation of the unconditioned bar-pressing response and the degree of light deprivation affect the level of responding.

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PLAYFULNESS AND DIVERGENT THINKING: AN INVESTIGATION OF THEIR RELATIONSHIP AT THE KINDERGARTEN LEVEL*[1]

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A. Introduction

Does the quality of a child's play provide a clue to his divergent-thinking abilities? The aim in the present study is to identify and rate the qualities of playfulness in the behavior of kindergarten children and to relate playfulness to the divergent-thinking factors of ideational fluency, spontaneous flexibility, and originality.

Quality of play has been mentioned in theoretical discussions (3, 15, 19) as well as in clinical appraisals of personality traits in young children (2, 11, 14). More attention, however, has been given to the functional aspects of young-children's play (5, 12, 18); and relatively little has been done to apply the newly developed concepts and measures of creativity or divergent thinking (4, 9, 10, 17) at the kindergarten or lower levels.

In observing children at play the author has noted individual differences in spontaneity, overtones of joy, and sense of humor that imply a relationship between the foregoing qualities and some of the factors found in the intellectual structure of creative adults and adolescents.

The author hypothesized that playfulness could be conceptualized and operationally defined in terms of five traits: physical, social, and cognitive spontaneity; manifest joy; and sense of humor. Further, she hypothesized

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that each of the foregoing traits formed a unitary behavior dimension in kindergarten children, and that the more-playful kindergarten children perform better on divergent-thinking tasks than do less-playful youngsters.

B. PROCEDURE

1. *Subjects*

The subjects were 93 kindergarten children (52 boys and 41 girls) from middle-class homes attending one of five private kindergarten classes in three New York City schools. The mean *CA* of the children was 5 years 6 months; the *SD* was four months.

2. *Methods*

The instruments used were a rating scale for playfulness, a test interview for divergent thinking, and the Peabody Picture Vocabulary Test (1).

a. The Playfulness Scale. The rating scale was specially constructed for this study, and the ratings were made on a five-point scale. Children were rated on the five traits of playfulness earlier named. Descriptive labels and samples of the behavior to be rated were given. To avoid contaminating frequency with intensity, ratings were requested for quantity (Part A) and quality (Part B).

Two questions not related to the play indices required ratings on intelligence and physical attractiveness.

In each kindergarten class, two teachers acted as raters. Twelve ratings, consisting of the 10 scores on Parts A and B of the five playfulness traits and the two scores on the additional questions, were obtained. The child's score on each trait was the pooled rating from the teachers.

Corrected reliability coefficients, obtained from correlating the ratings of the two teachers, range from .66 to .83 and have a mean of .70.

b. The Divergent-Thinking Tasks. Three tasks made up the test interview: (*a*) product improvement, a two-part, three-minute test in which the child was asked to suggest ideas showing how a toy dog and a doll could be changed to make them more fun to play with; (*b*) plot titles, a two-part, four-minute test in which two illustrated stories were read and shown, and the child was asked to supply names for the stories; and (*c*) the Monroe Language Classification Test, a three-part, one-and-one-half-minute test in which the child was asked to list the names of animals, things to eat, and toys.

The first two tasks were adapted to the kindergarten level, after Guilford (10) and Torrance (16). The Monroe Language Classification Test was used as it was in the study by Meyers *et al.* (13).

Scores on ideational fluency were obtained from all three tests. The product-improvement test and the Monroe Language Classification Test were also scored for spontaneous flexibility. The plot-titles test yielded two originality scores: a weighted score and a cleverness score. Reliabilities based on correlations between scores on the two parts of the product-improvement test and plot-titles test and based on the intercorrelations among the three parts of the Monroe Language Classification Test range from .56 to .87 and have a mean of .75.

c. MA, CA, and sex. Despite the fact that the author had no specific advance hypotheses about the influence of age, intelligence, and sex, she decided to examine the results in terms of these variables for additional information and for comparison with findings from other studies.

C. RESULTS

1. *Dimensionality of Playfulness*

A factor analysis (6) limited to the playfulness traits, the intelligence ratings, ratings of physical attractiveness, *MA,* and *CA* shows that a single centroid factor accounts for most of the common variance among the five playfulness traits. Four of the five playfulness traits have loadings in the middle 80s on the first centroid factor. The only exception is physical spontaneity, which trait has a loading in the high 70s.

Ratings on intelligence and physical attractiveness show considerably lower loadings, but if a value of .30 can be accepted as a minimum level for practical significance intelligence and physical attractiveness (as well as MA and CA) can be considered significant.

2. *Relationship Between Playfulness and Divergent Thinking*

The formula for the correlation of unweighted sums was applied to test the relationship between fluency, flexibility, and originality and each of the five playfulness traits separately as well as with the global-playfulness score.

Table 1 shows that each of the playfulness scores correlates significantly (at the .005 level, one-tailed test) with ideational fluency; and (with one exception) at the .01 or .05 levels with spontaneous flexibility and originality.

CA also correlates significantly with each playfulness trait (coefficients range from .27 to .36) and with ideational fluency and spontaneous flexibility (r's $= .28$ and $.25$).

TABLE 1
CORRELATION COEFFICIENTS BETWEEN PLAYFULNESS AND DIVERGENT-THINKING SCORES ($N = 90$)

Playfulness	Divergent-thinking scores: Ideational fluency	Spontaneous flexibility	Originality
Specific traits			
Physical spontaneity	.29[c]	.19[a]	.13
Social spontaneity	.36[c]	.25[b]	.25[b]
Cognitive spontaneity	.35[c]	.27[c]	.21[a]
Manifest joy	.33[c]	.20[a]	.22[a]
Sense of humor	.30[c]	.23[a]	.22[a]
Global score	.36[c]	.26[b]	.23[a]

[a] Significant at the .05 level (one-tailed test).
[b] Significant at the .01 level (one-tailed test).
[c] Significant at the .005 level (one-tailed test).

MA correlates significantly with four of the playfulness traits (coefficients range from .30 to .34)—the exception being physical spontaneity—and with all three of the divergent-thinking factors (r's = .27, .24, and .30 for ideational fluency, spontaneous flexibility, and originality respectively).

D. DISCUSSION

The results indicate that playfulness in kindergarten children provides clues to ease in functioning in a structured-test situation measuring ideational fluency, spontaneous flexibility, and originality.

A certain tentativeness about the relationship needs to be maintained, however, because of its contamination with *MA* and *CA*. Yet, the fact that a child's brightness and years of living influence both playfulness and divergent thinking allows one some interesting speculation. When Piaget talks about the "ludic" or playful aspect in play (15), he contends that at one point mastery of skills has to be achieved before an activity can be enjoyed for its own sake, for the function pleasure of it, or the pleasure of being the cause. Piaget's contention means that a certain competence needs to have been gained before the element of joyful spontaneity arises and allows further explorations. A similar idea appears in White's concept of competence (20). When White talks about effectance motivation, he refers to it as being seen most readily in the "playful and investigatory behavior of young animals and children" (20, p. 328). The finding that the brighter and older child is rated as the more playful and is tested as the more creative is, then, not altogether surprising.

The adequacy of the measuring instruments needs to be established more securely. While the present findings suggest a unitary trait of playfulness in play, references in the literature (4, 17) show playfulness and sense of humor as separate qualities in older elementary-school children and adolescents. Observers other than teachers might check the dimensionality of the trait because ratings made by nonteachers have been known to reduce the "halo" effect.

Because of the lack of factor analyses of the divergent-thinking tests at the kindergarten level, one may wonder whether the tests measure at that level the same factors as in older populations (7). To some extent, Guilford's findings that in adults impulsivity relates to ideational fluency and spontaneous flexibility (8) may indicate a similarity with the relationship found between these factors and playfulness in kindergarten children. Note, however, that we found a significant relationship between the divergent-thinking factors and the *MA* obtained from the Peabody Picture Vocabulary Test. If the latter test is a measure of convergent thinking, then no clear-cut separation between divergent and convergent thinking can be claimed.

Because an artificial test situation may not tap "creativity," one should obtain originality scores from spontaneous productions, such as the children's own stories, paintings, work in clay, and other media.

In linking personality traits to divergent thinking, the present study suggests a specific approach to further work. Playfulness implies freedom, spontaneity, and joy; so does divergent thinking.

E. SUMMARY

The hypothesis that there is a relationship between the quality of playfulness in children's behavior and divergent-thinking abilities (ideational fluency, spontaneous flexibility, and originality) was tested with 93 kindergarten children.

Two teachers in each of five classes rated each child on five component traits of playfulness: physical, social, and cognitive spontaneity; manifest joy; and sense of humor. Scores on the divergent-thinking factors were obtained from two tests adapted from tests authored by Torrance and Guilford and the Monroe Language Classification Test. An independent measure for *MA* was also obtained. Reliabilities of the playfulness ratings range from .66 to .83; of the divergent-thinking scores, from .56 to .87. A centroid-factor analysis shows playfulness to be a unitary behavior dimension. This dimension correlates significantly with measures of divergent thinking (r's range from .21 to .36), but interpretation of the relationships needs to reflect also

the influence of *MA* and *CA* and the tentative character of the measuring instruments.

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PARENTAL INTERACTION OF THE ADOLESCENT BOY*

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A. INTRODUCTION

In the last few years, the awareness of the importance of the home environment and the pattern of interaction between the parents and the child has become central in the search for a better understanding of personality development and adjustment. The adolescent years represent a crucial period in the formation of "identity" (7) and in the formation of values, ideals and attitudes; and the formation of values, ideals, and attitudes is profoundly influenced by the relations that obtain between the adolescent and his parents. Disturbances in the development of identity or the "identity diffusion" that has been thought to underly the defective adjustment of so many adolescents (and, subsequently, adults) in American culture has been traced to the influence of inconsistencies in intrafamilial relationships and early deprivation (4). Also, evidence has been provided that seems to link delinquency, which is a major symptom of identity diffusion, with a defect in parental identification and a lack of strong and open affection (2).

While the importance of the parent-child interaction has been widely accepted, no clear understanding has emerged as to what factors are crucial in the parent-child interaction. The importance of the mother's role has been accepted ever since Sullivan's work (13), but more recently the father's influence on a child's development has received emphasis. Andry's investigations (2) seems to imply that a child's failure to identify with his father and inadequate communication with his father are central elements in the etiology of delinquency. Further, current studies in family dynamics have focused on the importance of the father's role (5, 9, 10). Undoubtedly, the significant environment within a family is compounded not only of the level of adjustment and functioning of each parent individually or not only of the pattern of the interaction of the parents with each other, but also of the manner in which both parents interact with the growing adolescent. This study is directed to the assessment of the frequency of occurrence of certain typical parent-child interactions in a population of normal adolescent boys.

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B. Procedure

The results presented arise from a 217-item questionnaire that was given to 1278 high-school boys attending nine schools. The schools were private, denominational schools under Catholic direction and were located in the states of New York, Pennsylvania, New Jersey, and Maryland. The questionnaires were given with a standard set of instructions read to the subjects by the test administrator. The test forms were sent in a sealed envelope to each administrator, who opened the envelope in the presence of the subjects, and immediately after the questionnaires were completed resealed the forms in an envelope for delivery to the investigator.

The subjects were selected randomly according to classes in their respective schools and they represented the medium range in academic achievement in their schools. Three hundred thirty-one were freshmen; 313, sophomores; 343, juniors, and 291, seniors. Ages ranged from 13 to 18, with average ages as follows: freshmen, 14.3 years; sophomores, 15.2 years; juniors, 16.2 years; and seniors, 17.2 years.

Results from the questionnaire were tabulated, per cents were computed, and chi squares were determined (6, pp. 97-119).

C. Family Characteristics

The families from which the boys came can be described as average middle-class families, and the average family group consists of father, mother, and siblings. Only 13 per cent of the subjects reported any persons living in the home other than members of the immediate family group. In six per cent of the families the father was deceased; in two per cent of the families the mother was deceased. Eight of the subjects lost a parent before the subject reached the age of 2 years; 13, between the ages of 2 and 6; 28, between the ages of 6 and 10; and 41, after the age of 10. Only four per cent of the boys reported divorce or separation of parents, not an unexpected figure in a predominantly Catholic population.

The families, for the most part, appear to have been financially stable; but 21 per cent of the subjects reported that financial troubles were a source of difficulty at home, and 27 per cent of the subjects reported a mother engaged in some form of work outside the home. The parents were predominantly native-born Americans, with only 14 per cent of the fathers and 10 per cent of the mothers having been born outside the United States. The proportion of Catholics in this population is strong: 91 per cent of the fathers and 96 per cent of the mothers profess the Catholic faith.

The only significant difference between fathers and mothers is educational level (1). Seventy per cent of the fathers and 72 per cent of the mothers had progressed beyond the high-school level, but 37 per cent of the fathers and 54 per cent of the mothers failed to finish college. Thirty-three per cent of the fathers and only 17 per cent of the mothers had graduated from college or had received some postgraduate training.

Not quite 13 per cent of the boys indicated that illness is a source of frequent home difficulty.

D. PERCEPTION OF PARENTS

Whatever may be the attitudes or behavior of parents toward their children, the effect on the children is mediated through the children's perception of them (3) and there seem to be detectible differences between the perceptions of parents and adolescents. Hess (8), for example, has shown that (while the descriptions of teenagers of themselves tend to agree with descriptions of them by their parents) teenagers expect their parents to underrate them; and parents expect the teenagers to overestimate the maturity and ability of teenagers. Adolescents rate parents higher than parents rate themselves on every item on which adolescents were questioned. These findings can be explained easily on the basis of the high valuation put on adult status by the adolescent who is struggling to define his own identity; but, at the same time, the explanation raises the question of the relationship between the objective situation and the adolescent's perception of it. In other words, the adolescent's perception of his home and parents is colored to a certain extent by his own needs.

The questionnaire responses suggest that certain differences exist between the perceptions of fathers and mothers and that these differences may be meaningful for understanding the interactions between adolescents and their parents. The differential parental characteristics can be listed as follows:

Father	*Mother*
Colder and more indifferent.	More friendly and interested.
More old-fashioned.	More nervous.
Less understanding.	More understanding.
More unreasonable.	More reasonable.

Thirty-five per cent of the students felt that their fathers were cold or indifferent; only 13 per cent thought this of their mothers. Fifty-one per cent thought their fathers more or less old-fashioned; 41 per cent regarded their mother that way. Thirty-nine per cent thought their fathers understood the subject's difficulties; 54 per cent thought their mothers did. Thirteen per cent thought their fathers "nervous"; 30 per cent perceived their mothers as "nervous."

The typical relationship that emerges is decidedly more positive in regard to the mother than it is in regard to the father. Although the configuration may or may not run counter to the presumptive identification of the male child with the father figure, it raises a question about the influence of typical parental perceptions on the course of child development. Apparently the father figure becomes fixed with the role of mediator of parental authority and restriction; while the mother is perceived as responding more to emotional needs for sympathy, acceptance, and understanding. Moreover, the trends in the data, while not always significant, suggest that the foregoing perceptions become more dominant as one moves from the first year to the senior year of high school.

In general, the attitudes toward parents tapped by our questions were positive. The majority thought their parents not overly careful or concerned about them (62 per cent) or overly strict (85 per cent). Most felt proud of their parents and liked to have them meet their friends (74 per cent).

E. Parent-Child Interaction

As the young boy proceeds through the adolescent period, the pattern of his interactions with his parents shifts in both positive and negative dimensions. The dimensions of interaction, in which the shifts are statistically significant ($p < .05$), can be listed as follows:

Positive

1. Increased feeling of adequate social opportunity.
2. Increased feeling of sufficient social freedom.
3. Increased acceptance of parental authority.
4. Increased valuation of father's guidance.

Negative

1. Increased dissatisfaction with home life.
2. Increased unhappiness in the home.
3. Decrease in amount of leisure time spent at home.
4. Increased conflict with parents over religion.
5. Decreased approval of parental guidance.
6. Increase in seeing friends disapproved by parents.
7. Increased feeling of the imposition of parents' ideas.
8. Decreased valuation of father's understanding of personal problems.
9. Increased feeling of being misunderstood by parents; more misunderstood by father than mother.

The overall picture is one of gradual alienation from parental influence and increasing rebelliousness against parental control. The shifts, however, are variable. As might be expected, reports of satisfaction and happiness in the home situation are high (80 per cent and 89 per cent respectively), and a large majority (84 per cent) report that half or more of their leisure time is spent at home. Dissatisfaction and unhappiness, however, increase significantly as the boy grows older.

Religious belief does not provide a singular source of conflict. Only seven per cent report that differences in the religious beliefs of their parents have ever caused them any difficulty, and only 16 per cent report that they have ever come into conflict with their parents on the question of religion. There is a trend, however, toward increasing conflict as the boy grows older. This pattern coincides with the previously reported finding (11) that religious belief becomes a primary source of serious doubt for this same group in their junior and senior years. This increasing concern would be likely to express itself in conflict with the parents.

Most of the boys do not feel that their parents' demands are excessive, but 18 per cent feel that their parents expect more than they can ordinarily accomplish. The large majority, however, approve of the manner in which their parents guide them (73 per cent). These attitudes undergo a significant shift ($p < .01$) between the freshman year (79 per cent) and the junior year (68 per cent).

The adolescent period is one of increasing social and heterosexual contacts; consequently it is to be expected that the regulation of these activities provides a common source of friction between the adolescent and his parents. In general, the majority of our subjects report that their parents encourage them to bring their friends into the home (75 per cent) and, to a lesser extent, that their parents approve of all their friends (54 per cent). Parental approval is reported as increasing steadily until the junior year and dropping off sharply in the senior year ($p < .02$). However, when parents do not approve of particular friends, only 34 per cent stop going with those friends.

Most of the parents (75 per cent) have the practice of setting a time for their sons to be home at night, but the practice seems to be observed less frequently as the boys grow older (freshmen, 83 per cent; sophomores, 82 per cent; juniors, 76 per cent; and seniors, 60 per cent). The difference between seniors and each of the other groups is significant at the .01 level; that between juniors and freshmen is significant at the .05 level. Coincident with a relaxation of parental restriction, there is an increasing feeling that the boys are being treated as maturely as they should be (freshmen, 54 per cent; sophomores, 64 per cent; juniors, 73 per cent; and seniors, 77 per cent). A majority of the boys (66 per cent) feel that they are given as much social freedom as other boys, and the frequency of that feeling parallels closely their feelings of being maturely treated (freshmen, 55 per cent; sophomores, 65 per cent; juniors, 70 per cent; seniors, 74 per cent). One-half of the boys (50 per cent) claim that they argue for greater liberty when they feel they deserve it.

In a minority of cases, parents are listed as the first source of sex information. Fathers are given as the source of first sex information by 22 per cent of the boys; mothers, by 20 per cent. For the most part, parents seem to be successful in giving such information. Only 11 per cent of the boys report that they lost confidence in their parents because of the way the sex issue was handled. In the majority of cases (73 per cent), the parents are acquainted with the girls whom the boys date, and conflict with the parents over girl friends is not frequent (13 per cent).

A large majority of the boys (87 per cent) recognize that parents exercise legitimate authority over them, but the figure fluctuates significantly between class groups. The shift that occurs between the freshman and senior years may reflect a maturing acceptance of the intellectual awareness of the grounds of parental authority or it may reflect a greater degree of identification with adult figures and adult status. In any case, parents are selected as the persons whom the boys obey more frequently than they do any other authority figure (83 per cent). Ninety per cent of the boys report that they understand the reason why they should obey their parents.

Parental authority, however, is not accepted without resistance. A small minority of the boys feel that the discipline in the home is too severe (10 per cent), and 19 per cent express the feeling that they are not treated as young men of their age should be treated. The majority, however, feel that in the exercise of responsibility their parents give them sufficient opportunity (58 per cent). At the same time, 28 per cent are not satisfied with the opportunities made available to them for responsible activity. Some boys (32 per cent) report that they are frequently scolded by their parents, and an even larger number (42 per cent) express the feeling that parents tend to impose their own ideas and customs. This latter feeling grows more frequent as the boy matures, possibly because of the increasing influence on him of opinions and attitudes derived from his peer group and because of other influences external to the home. Finally, 14 per cent feel that parents exert too much authority over them.

Negative attitudes toward parental authority and discipline are damaging because the internalization of parental norms is an essential step in the development of a responsible person. The formation of a mature identity depends in part on the stable and mature use of authority on the part of the parents; so unless the adolescent maintains positive attitudes the developmental pattern is more likely to be one of rejection and rebellion than one of acceptance. More often than not the question of rebellion does not arise so much as does question of the adolescent's need and desire to establish his independence. When parental norms are presented in an authoritarian manner there is a tendency to develop negative attitudes toward them, and this tendency becomes more noticeable as the child grows older or shows better verbal intelligence. When parental restrictions are presented with rational motivations there is a tendency for positive attitudes to assert themselves (12).

Perhaps the most important area of interaction between the adolescent and his parents is that of communication. It is particularly during the period of adolescence that the maturing young man needs the counsel and advice of his elders to enable him to work his way through the conflicts and turmoil characteristic of that period of development. In the present study, 33 per cent of the boys claim that they do discuss difficulties and personal problems with their fathers. Almost 39 per cent feel that their fathers understand their difficulties, while the rest of the subjects are divided between those who feel their fathers do not understand them (30 per cent) and those who are still undecided (31 per cent). There is a definite trend between the freshmen and the seniors (freshmen, 45 per cent; seniors, 33 per cent) to call into question the father's understanding. Fifty-three per cent of the boys say that they discuss their problems with their mothers, and 54 per cent feel that the mother understands the difficulties.

The father's influence regarding guidance seems to become relatively more dominant as the boy grows older. This trend presents a pattern much different from the previously observed pattern of discussing problems and difficulties. Apparently, adolescent boys turn to the father when there is a question of working out the ordinary everyday affairs; but, when immediate problems and difficulties arise, they tend to turn to the mother.

A small per cent of the boys (nine per cent) report that they fear their fathers rather than love them. In all age groups, there is a consistent tendency to feel more often misunderstood by the father than by the mother. The fixation of the perception of the mother establishes an expectation of continued feminine responsiveness in the future marriage relationship. The more negative fixation of the perception of the father, however, may have the effect of inhibiting the acceptance of the more masculine characteristics that depend on internalization of norms of restrictive discipline. Internalization is essential to the development of a strong sense of masculine identity. At the same time, the positive aspect of the significantly increased valuation of the father's guidance must be kept in mind.

The results of this study imply that there is a pattern of increasing alienation from parental influence and control that can be traced through the critical years of adolescence. There is a growing acceptance of the principle of parental authority and increased respect for parental judgment, especially significant because the strong Catholic influence would have been expected to have reinforced parental authority and to have stressed the value of obedience.

It is not clear, however, that the independent indications justify an identification of the visible pattern as one of rebelliousness. Analysis in terms of "rebelliousness" may reflect a prejudice dictated by a vested interest. From the point of view of the adolescent, the growing indications of decreasing parental authority may represent nothing more than a critical phase of differentiation from parental influence: an essential part of development toward mature and independent functioning.

In conclusion, the author suggests that there is a relationship between identifiable perceptions of parental figures and patterns of interaction between the adolescent and his parents, and that there is a determinable shift in these perceptions reflected in shifting patterns of interaction.

F. SUMMARY

A total of 1278 high-school boys were asked to answer 217 questions on areas of interaction between themselves and their parents. The results indicate that certain typical perceptions of father and mother can be identified, and that these perceptions are significantly different. Also identified were patterns of interaction that reveal significant shifts between the early and the late years of high school. The shifts, generally, are in the direction of parental alienation and increased rebelliousness. An attempt was made to relate the boys' perceptions of parental perceptions to the developing pattern of interaction with the parents.

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MODIFIED WORD RECOGNITION, READING ACHIEVEMENT AND PERCEPTUAL DE-CENTRATION*

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A. INTRODUCTION

One hundred and eighty children, including at least 25 at each grade level from 2 through 6, were tested for recognition of modified words, reading achievement, and perceptual de-centration. Results showed a regular increase with age in children's ability to recognize known words in modified form; that, at all grade levels, ability to recognize modified words is positively correlated with reading achievement; and that modified word recognition and reading achievement are positively correlated with nonverbal measures of perceptual de-centration. Results of a factor analysis of the correlations implies a hierarchical order, with a de-centration factor common to all three types of measures, together with specific factors peculiar to verbal and figural perception. These results favor Piaget's logical model of perceptual development and suggest a means of integrating Piaget's normative findings with those of differential psychology.

B. BACKGROUND

The present investigation grew out of several previous attempts to apply Piaget and Morf's logical model of perceptual development (13) to the perception of meaningful materials. In the preceding studies, the model led to successful predictions regarding the course of developmental changes in the perception of ambiguous figures (2, 3, 5) and in the perception of part-whole figures (4). The success of these previous efforts emboldened the authors to apply the model to a much more difficult and complicated form of perceptual activity: namely, reading. In the present paper we present the results of an exploratory attempt to deal with the problems of word recognition and reading achievement, from the standpoint of Piaget's logical model for perceptual development. To make the presentation meaningful, however, it will be necessary for us to summarize Piaget's logical model and describe the way in which we extended it to the perceptual aspect of reading.

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Although Piaget is known primarily for his work on the development of intelligence, he has for many years been concerned with the development of perception—as evidenced by numerous journal articles published in the last 20 years and by his recent book (12) summarizing this work and giving an extensive presentation of his probabilistic model for perception. Piaget and Morf (13) have also described (but not systematically explored) what might be called a logical model for perception. In contrast to the probabilistic model (which treats the stimulus array as a collection of elements the quantitative dimensions of which affect judgment), the logical model treats the stimulus array as a collection of elements the logical relationships of which determine perceptual organization. Because the forementioned logical model is little known or explored, and because we feel it deserves more attention than it has received, we have used it as the starting point for our investigations.

Briefly, Piaget's logical model implies that perception *develops,* and that the development follows a predictable sequence of events. In the young child, perceptual organization tends to be dominated by Gestalt-like principles (such as good form, closure, and contrast) which Piaget calls *field effects.* The young child's perception also tends to be static in the sense that it takes the dominant perceptual organization as the only possible organization. This static quality of perception in the young child is one reason that Piaget speaks of it as *centered* perception. With increasing age, however, perception becomes increasingly freed from its earlier domination by field effects. This liberation is brought about by the development of a new, higher-order, perceptual system made up of internalized sensorimotor acts which Piaget calls *perceptual regulations.* In its mode of activity, the system of perceptual regulations functions in a manner analogous to the operational system of abstract intelligence; i.e., both systems group and regroup problematic elements. The system of regulational perception, however, differs from the system of operational thought, in that the former never attains complete reversibility —i.e., there is not a reciprocal regulation for each regulation in the system. Despite its lack of complete reversibility, the regulational system of perception in the older child spontaneously analyzes a given configuration into component elements and then rearranges them according to logic-like rules. This dynamic quality of perception in older children is one reason that Piaget speaks of the perception of older children as *de-centered.*

Despite the fact that this brief sketch of Piaget's logical model of perception is far from adequate to convey all of its details, it will suffice as a preface to the application of the model to the problem of word recognition.

The authors, starting from the premise that perception develops, reasoned that the young child's process of recognizing words is not the same as that of the older child. Furthermore, the authors reasoned that the difference was more than a change from letter to word to phrase habits and involved a shift from a passive, static recognition of printed matter to an active, dynamic reading process. To put this hypothesis in operational terms the authors found it useful to distinguish two ways in which words can be presented for recognition.

In *standard presentation* the word appears as it was originally learned: that is, with its letters in their customary order and spatial orientation. The standard presentation of words is found in books, newspapers, and magazines.

In *modified presentation* the word appears in a form different from that in which it was originally learned: that is, with its letters in an unusual order or spatial orientation. The modified presentation of words is illustrated in anagrams, crossword puzzles, "Scrabble," and other word games.

So far as word recognition is concerned, the mode of standard presentation corresponds to the dominant organization of the visual field—but, in this case, the dominance of the standard organization is probably determined more by learning than by inborn organizing principles. In contrast, the modified presentation corresponds to secondary or subsidiary possible organizations. Stated in the foregoing terms, Piaget's model implies that the *young* child will have difficulty in recognizing words he can identify in standard form when these words are presented in modified form. This conclusion follows from the assumption that the perception of the young child is *centered* and that he takes any dominant presented form as the only possible organization of the visual field. If this assumption holds, the young child will regard a known word presented in modified form as a new and unrecognizable perceptual figure.

On the other hand, the *older* child, whose perception is regulational and de-centered, should encounter less difficulty in recognizing known words presented in modified form. More highly developed perceptual regulations will enable the older child to manipulate the given figure—either as a whole or as a set of parts. The capacity for such mental manipulation should enable the older child (by mental rearrangement or reorientation of parts or wholes) to discover the familiar word even in its modified form. One purpose of the present study is to determine whether or not there is a change with age in the ability to recognize known standard-form words when presented in modified form.

If found, age changes in the recognition of modified words would not afford evidence as to whether or not de-centration is involved in *reading achievement* or in the number and difficulty of words a child can read or identify. But, in theory, de-centration would seem to be one of the determinants of reading achievement. This conclusion follows from a consideration of some of the requirements for proficient reading. It seems that one requirement would be the ability to deal with the fact that one and the same letter or letter group can have more than one pronunciation. The "t" in "the," for example, is pronounced differently than the "t" in "too." Another requirement for proficient reading would seem to be the ability to discern that a large word, such as "waterfall," can be made up of smaller words with independent meanings.

Both of the foregoing requirements for proficient reading could be interpreted as being met by the presence of perceptual regulations. In the case of letters with multiple sounds, regulations would permit the child to detach a letter from its context and permit him to discover the different ways in which it can be expressed. The way in which perceptual regulations might permit the child to deal flexibly with letter elements can be demonstrated by a logical paradigm. Let "W" = the word "the"; "l," the letter "t"; and "c," the remainder (or context), "he." Then, once regulations are in effect the child can recognize the following equalities: (*a*) $W = l + c$; (*b*) $l = W - c$; and (*c*) $c = W - l$.

In words, the word "the" is equal to the letter "t" plus the context "he"; the letter "t" is equal to the word "the" minus the context "he," and the context "he" is equal to the word "the" minus the letter "t." Once these equalities are known (and one can find examples of them on the blackboards in many classrooms), the child has recognized the fact that one and the same letter or letter group can be expressed visually in several different ways. From this insight it is but a simple extension to the realization that one and the same letter or letter group can also have more than one sound expression.

The way in which perceptual regulations might enable the child to discover that a large word can be made up of smaller words can be shown in a similar way. Let "W" = the word "waterfall"; P_1, the word "water"; and P_2, the word "fall." Then once regulations are in effect the child will be able to construct the following equalities: (*a*) $W = P_1 + P_2$; (*b*) $P_1 = W - P_2$; and (*c*) $P_2 = W - P_1$.

In words, the word "waterfall" equals the word "water" plus the word "fall," etc. The regulations should enable the child to discover that one and the same word can be expressed in several different ways and that it can be made up of several independent parts.

We do not claim that the child is consciously aware of the foregoing equations to the extent of being able to verbalize them; but we do claim that for proficient reading to take place a logic-like analysis must occur at some level of psychic functioning. Such a view is not farfetched. Even four-year-old children show implicit logical organization in their use of various language structures.

If the foregoing requirements for proficient reading are correct, and if they are met by the presence of regulations, one should expect (other things being equal) the de-centered reader (as measured by his skill in the recognition of modified words) to be a proficient reader (as measured by the number and difficulty of the standard words he can read or identify). A second purpose of the present study is to test this hypothesis by correlating, at each grade level, children's success in the recognition of modified words with success on tests of reading achievement.

A significant correlation, however, between skill in recognizing modified words and reading achievement would not be sufficient evidence for inferring that the two tasks involve the same process: namely, perceptual de-centration. Such a correlation would indicate only that the proficient reader of modified words is also a proficient reader of standard words. In other terms, the correlation might be due not to a common de-centration ability measured by both types of tasks but to the fact that the proficient reader of standard words, in all likelihood, is also the more experienced reader. Because the more experienced reader will tend to have overlearned the standard form of words more thoroughly than the less experienced reader, the former might have an advantage for recognizing words in modified form. This argument implies, then, that the more familiar the child is with a word presented in standard form, the more likely he is to recognize it when it is presented in modified form.

Experimental evidence regarding the familiarity hypothesis is equivocal. Osgood, for example, in summarizing the work dealing with the effects of degree of learning on transfer and retroaction of verbal and motor behavior concluded that "As the amount of practice on the preceding material is increased towards high degrees of mastery, *both facilitative and interfering effects appear to reach a maximum and then decrease in magnitude*" (11, p. 539).

A similar equivocalness is apparent in the literature dealing with the effects of previous practice upon the recognition of figural material. Gottschaldt (6), for example, found that subjects given repeated experience with a simple geometric figure fared no better than nonexperienced subjects when required to find the simple figure embedded in a more complex figure. On the other hand, Djang (1)—with stimuli different from those used by Gottschaldt—found that experimental subjects were far superior to controls in finding hidden figures on which training had been given. Thus, past results give no clear warrant for predicting whether greater familiarity with words presented in standard form will facilitate, not affect, or inhibit their recognition in modified form.

In the present study, the authors take a more direct, experimental approach to the question of alternative and competing explanations for the same phenomenon. Our model implies that, if familiarity is the sole or principal explanation for an observed positive correlation between recognition of modified words and reading achievement, there is no strong *a priori* reason to suppose that performance in word recognition and reading achievement tasks correlate significantly with performance on other tasks that require de-centration but that *do not* involve familiarity with words. Explanation, however, in terms of a unitary process of de-centration implies such correlation. Indeed, it requires it! Hence, if one finds that success in the recognition of words in modified form and reading achievement correlate consistently and positively with measures obviously not semantic [but which have been shown by previous research (2, 3, 4, 5) to require de-centration], then one can infer that the essential process that *all* the performances involve (and which produces the positive manifold and perhaps the hierarchical order among the correlations) is not merely familiarity with words but must be some more fundamental process common to both verbal and nonverbal tasks; and the principal alternative hypothesis—de-centration—becomes the more likely. So, a third purpose of this study is to discover whether or not measures of modified word recognition and reading achievement do correlate with established, largely nonverbal measures of perceptual de-centration and correlate in a manner such that all the performances can be said to involve the single de-centration process.

C. METHOD

1. *Subjects*

One hundred and eighty children attending school in a suburb adjoining Denver participated in the study. By and large, the children represent lower middle-class homes, and school personnel estimate the children (for the most part) to be of average mental ability. *IQ* scores were available for some of the children, but appeared to be so variable in reliability that we did not tabulate them. Grades 2 through 6 were represented in the study. Table 1 shows the number of subjects, the mean age, and the standard deviation for each grade level.

2. *Pretest: Word-Recognition Test*

This test was used to ensure that the words included in the two modified word-recognition tests (Scrambled Words and Rotated Pictures and Words) could be recognized in standard form by at least 90 per cent of the children at each grade level. Eight words (go, was, out, went, tray, split, image, and object) taken from a second-grade reader; 10 common color words (red, white, black, green, brown, yellow, orange, purple, gray, and blue); and 10 number words (every number word from one to 10) were used in the test. Each word, in primary-reader type, was printed in a row together with three other words of comparable length and composition. That is to say, the words paired with the correct word began either with the same letter or letter group or contained common vowel sounds. The position of the correct word in the row was determined by reference to a table of random numbers. All 28 rows were mimeographed on a single 11″-×-8½″ sheet with work samples at the top. The test was group administered. After the examiner made sure that each child had correctly completed the simple work samples, he said the row number, spoke the correct word, used the word in a sentence, and then said the word again. The children were asked to circle the word pronounced by the examiner.

With the exception of one word ("image"), each of the correct words was circled by more than 90 per cent of the children at each grade level. Because the word "image" was correctly recognized by 80 per cent of the second-grade children and by more than 90 per cent of the children in the remaining grades, we decided to include it in the tests of modified-word recognition.

3. *Tests*

The tests of de-centration were as follows:

a. Measures of modified-word recognition.

(1). *Scrambled words.* The order of the letters in the 10 color and 10 number words (taken from the Word-Recognition Pretest described earlier) was randomly rearranged, and the "scrambled" words were mimeographed in two columns on a single 11″-×-8½″ sheet containing instructions and work samples at the top. The test was administered on a group basis. After the examiner read the instructions and made sure that all the children had correctly done the work samples, the children were given 10 minutes to recognize and write the correct words. The children knew, before the test began, that the left-hand column contained color words; the right-hand column, number words. The child's score was the total number of successfully unscrambled words.

(2). *Rotated words and pictures.* Four silhouette pictures, made from tracings of the object-assembly figures of the Wechsler Intelligence Scale for Children and the eight second-grade-reader words used in the word-recognition test (described earlier) were drawn with India ink on 11″-×-8½″ tagboard sheets. The test was administered individually in a small room adjoining the classroom. Each child was seated opposite the examiner and was told that the examiner was going to show him some pictures and words upside down and ask him to say what they were as quickly as possible. The cards were shown one at a time in the following order: silhouettes—face, man, horse, car; words—go, was, out, went, tray, split, object, image. In each case, the silhouette or word was presented in 180-degree rotation from its usual position; and the child was given up to one minute to recognize the rotated picture or word.

For each correct reading within the time limit, the response time in seconds was recorded. If the youngster failed to respond within one minute or if he gave a wrong response, the raw score for that item was recorded as 60 seconds. The total raw score was determined by summing the item scores and by subtracting the sum from a constant.

b. *Measures of reading achievement.*

(1). *Run-on sentences.* Twenty sentences taken from Grade Readers 1 through 5 were mimeographed in primary-reader type on 11″-×-8½″ sheets. There were no spatial separations between individual words, but sentences were separated and numbered. A sample sentence at the top of the sheet permitted the child to practice placing scoring marks in the correct places. After all the children had completed the work sample, they were given 20 minutes to separate, by drawing lines, as many words as possible. The child's score was the total number of correct separations minus the number of errors of omission (failure to separate) and of commission (wrong separations).

(2). *Wide-range reading achievement.* This widely used achievement test (19) contains 120 words of increasing difficulty to be read by the child during an individual administration. The child is told to "Look at each word carefully and read it out loud as well as you can. Begin here [examiner points to the appropriate line] and read the words across the page, this line first, then the next . . ." (19, p. 5). Testing is continued until the child gives 10 consecutive incorrect readings. The test was scored according to the directions given in the manual, and grade levels (measured in years and decimal fractions) were determined.

c. *Measures of nonverbal de-centration.*

(1). *Hidden-figures test.* Fourteen modified Gottschaldt figures taken from Thurstone (14) were mimeographed on 11″-×-8½″ sheets with work samples at the top. The test was group administered, and the children were instructed to mark with a colored pencil the simple figure hidden inside the adjacent complex figure. The children were given 10 minutes to complete the task. Each child's score was the number of simple figures correctly marked in the complex figures.

(2). *Diamond-illusion test.* This test was devised in part for the present study. The diamond illusion is the overestimation of the size of a square standing on a corner compared with that of square of equal size lying on its side. The test consists of four sample cards and 12 test cards. The sample cards contain squares of equal and unequal size and are used to determine whether or not the subject understands the terms "same size," "different size," and "larger than." Eight of the test cards contain paired squares and diamonds in various right-left and solid-outline combinations, and four of the test cards contain paired equal squares one of which contains a black dot in either the center or corner position. These square-plus-dot cards are included as set breakers to guard against systematic error. The child's score was the number of correct size judgments given to the 12 test cards. The paired equal squares were included in the scoring although they are not direct measures of the diamond illusion. This was done because the cards contained a possible illusion and because including them increased the variability (hence increased the reliability) of the scores.

D. RESULTS

The means, standard deviations, and product-moment intercorrelations for all variables for each of the five grade levels and for the total sample are given in Tables 1 and 2.

1. *Age Changes in the Recognition of Modified Words*

To evaluate age changes in the recognition of modified words, the means of the two modified-word recognition tests (Scrambled Words and Rotated

TABLE 1

MEANS, SIGMAS, AND F RATIOS FOR SIX MEASURES ACROSS FIVE GRADE LEVELS

Measure	2nd grade $N = 25$ Mean	SD	3rd grade $N = 25$ Mean	SD	4th grade $N = 29$ Mean	SD	5th grade $N = 51$ Mean	SD	6th grade $N = 50$ Mean	SD	Total $N = 180$ Mean	SD	F
Rotated words[a]	12.62	11.02	16.24	10.88	22.27	10.40	25.84	9.41	23.76	10.16	21.52	11.23	9.42*
Run-on sentences	8.74	3.91	13.04	5.10	16.36	6.11	19.45	6.20	16.45	6.89	15.74	6.91	16.52*
Scrambled words	10.12	5.23	12.68	5.50	17.07	3.45	17.76	3.53	16.84	3.65	15.63	4.96	20.00*
Wide-range reading	3.64	1.00	4.01	1.12	4.99	1.39	5.66	1.55	5.51	1.55	5.00	6.00	12.94*
Hidden figures	9.40	2.76	10.44	2.71	11.86	2.64	12.22	1.96	12.60	1.50	11.63	2.48	11.07*
Diamond illusion	5.16	2.88	7.00	3.93	7.45	4.31	10.24	2.88	8.60	3.45	8.18	3.84	27.99*
Age (in mos.)	90	3.68	100	3.04	114	4.95	125	4.35	140	7.12	114	4.63	—

[a] This variable reflected, so that a numerically large score is associated with success.

* Significant beyond the .01 level.

TABLE 2

SIGNIFICANCE OF CORRELATIONS BETWEEN MEASURES OF MODIFIED-WORD RECOGNITION AND READING ACHIEVEMENT FOR FIVE GRADE LEVELS

Measures correlated	Grade 2 $N = 25$		Grade 3 $N = 25$		Grade 4 $N = 29$		Grade 5 $N = 51$		Grade 6 $N = 50$	
	r	t	r	t	r	t	r	t	r	t
Rotated words and wide-range reading	.734	5.19*	.781	5.99*	.599	3.88*	.647	5.93*	.411	3.13*
Scrambled words and wide-range reading	.732	5.15*	.743	5.32*	.688	4.93*	.510	3.08*	.533	4.37*
Rotated words and run-on sentences	.361	1.86	.675	4.38*	.647	4.41*	.684	6.55*	.460	3.59*
Scrambled words and run-on sentences	.449	2.41	.817	6.79*	.725	5.05*	.750	7.95*	.570	4.80*

* Significant beyond the .01 level.

Pictures and Words) for the five grade levels were tested for significance by a simple one-way analysis of variance. The obtained F ratios, together with those for the other tests used in the study, are presented in the extreme right-hand column of Table 1.

Except for the scores for the sixth-grade group, there is a regular and significant increase with age ($p < .01$) in the successful recognition of words presented in modified form. The failure of the sixth-grade group to conform to the developmental pattern is attributable to an unfortunate sampling error discovered after the study was completed. A practice of the school system furnishing our subjects is *not* to detain slow learners until the sixth grade (i.e., until just before they enter junior high school); so the sixth-grade classes had a preponderance of slow learners and it was the performance of these slow learners that lowered sixth-grade mean scores. In a replication study, in which all the classes were homogeneous with respect to ability, the expected result was obtained: namely, that the sixth-grade group scored higher on all measures than did the fifth-grade group. It seems reasonable to conclude that for groups of comparable *IQ* there is a regular increase with age in ability to recognize words presented in modified form.

2. *Correlations Between Measures of Modified-Word Recognition and Reading Achievement*

The significance of the intercorrelations between the modified-word recognition tests and the reading-achievement tests was evaluated by means of the t test for small samples. The results, together with the intercorrelations, are given in Table 2.

With two slight exceptions, at all age levels the correlations between the tests of modified-word recognition and the tests of reading achievement are high and positive ($p < .01$).

3. *The One-Factor (De-Centration) Hypothesis*

In view of the small samples, the intercorrelations could be regarded as largely affected by sampling error; therefore, the matrix for the *total* sample was accepted as the most stable pattern upon which to base subsequent analyses. To eliminate as far as possible the factor reflecting only the gross differences associated with chronological age, that factor was partialled in all intercorrelations, with the results shown in Table 3. In that table, the variables are arranged to show the orderly pattern of decrease in correlation characteristic of hierarchical order.

TABLE 3
PARTIAL CORRELATIONS (BELOW DIAGONAL), SPEARMAN-FACTOR COEFFICIENTS (IN DIAGONAL), RESIDUALS (ABOVE DIAGONAL), AND STANDARD ERRORS

	Variable					
Variable	1	2	3	4	5	6
1. Rotated words	(800)	—039	067	001	—002	—061
2. Run-on sentences	594	(792)	—085	—092	—094	—113
3. Scrambled words	681	692	(766)	024	—003	—106
4. Wide-range reading	606	690	604	(756)	—037	—124
5. Hidden figures	343	248	334	289	(431)	057
6. Diamond illusion	261	224	201	180	231	(402)
7. Sex	026	—030	—012	030	133	100
Standard-error residual	0717	0664	0640	0739	1125	1137

The *g* loadings entered in the principal diagonal of Table 3 were determined by the method of triads, as described by Harmon (7); and the variation among all possible independent values for the triads was examined by means of the appropriate standard error, as developed by Holzinger and Harmon (8). The residuals, after one factor was extracted, are given above the diagonal; and the standard deviation for the residuals (as developed by Holzinger and Harmon) for each variable are presented in the last row of Table 3. The average (absolute value) residual is .0488; the average error, .0749.

Although the unitary factor assumption is tenable, we deem it necessary to examine the description afforded by multifactor procedure. Such description is preferred by many investigators and provides evidence for the interpretation of the components of the positive manifold of the matrix of Table 3.

We extracted centroid factors, using the highest-element method for estimating communality and following Thurstone's procedure (15) for re-estimating the communality of the residual matrix after each extraction. Sex differences were treated as a variable. Ninety-eight per cent of the common variance is accounted for by the three factors shown in Table 4. These three factors were rotated to approximate the simple structure provided by Kaiser's analytic varimax criterion (10). The rotated factors, along with their distributed variance, are presented in Table 5.

E. DISCUSSION

The results of the present study show (*a*) that the recognition of known words presented in modified form increases regularly with age, (*b*) that

TABLE 4
CENTROID FACTORS, COMMUNALITIES, AND FACTOR VARIANCES

Variable	Factor I	 II	 III	h^2
Scrambled words	762	353	266	776
Run-on sentences	778	286	— 168	716
Rotated words	790	131	161	667
Wide-range reading	769	221	— 236	696
Hidden figures	472	— 264	163	319
Diamond illusion	371	— 288	058	223
Sex	062	— 320	— 093	114
Factor variance	2.765	.526	.220	3.511

TABLE 5
VARIMAX SOLUTION WITH COMMUNALITIES AND ROTATED FACTOR VARIANCES

Variable	Factor I	 II	 III	h^2
Scrambled words	513	703	— 137	776
Run-on sentences	763	367	000	716
Rotated words	521	621	097	667
Wide-range reading	774	303	069	696
Hidden figures	155	400	368	319
Diamond illusion	135	253	375	223
Sex	— 009	— 058	333	114
Factor variance	1.758	1.333	0.420	3.511

veridical recognition of words presented in modified form is highly correlated with reading achievement at all the age levels studied, and (*c*) that measures of modified-word recognition and reading achievement involve a factor in common with measures of nonverbal perceptual de-centration.

1. *Age Changes in the Recognition of Modified Words*

Piaget's logical model of perceptual development implies that the *young* child has difficulty in recognizing words he can ordinarily read if these words are presented in an unusual way, and that this difficulty is overcome with the development (with age) of perceptual regulations and the consequent de-centration of perception. Our results are in keeping with this implication. For words that are recognized in standard form by more than 90 per cent of the children at each grade level, there is a regular increase with age in ability to recognize the words in modified form. While the findings with regard to age changes in the recognition of modified words in no way prove that de-centration is involved, they are consistent with the hypothesis that with age the perceptual process becomes increasingly dynamic and more able to deal flexibly with perceptual "givens."

2. *Correlation Between Modified-Word Recognition and Reading Achievement*

Piaget's logical model for perception implies that de-centration is one of the necessary conditions for proficient reading. Presumably, one characteristic of a proficient reader is an ability to recognize that the same letter or same letter grouping can have different sounds and that large words can be made up of independent smaller words. Because (according to our interpretation of Piaget's model of perceptual development) the recognition of modified words also involves de-centration, we expected to find a correlation between reading achievement and success in recognizing words presented in modified form. This correlation we found to be present at all age levels studied, therefore our results are in keeping with the view that a common ability underlies reading achievement (as measured by the number and difficulty of words a child can read) and the recognition of modified words (as measured by success in recognizing previously learned words in scrambled or rotated form). The correlations, however, between modified-word recognition and reading achievement do not prove the de-centration hypothesis because they could be equally well explained on the basis of familiarity or experience.

3. *Factor Analysis of Modified-Word Recognition, Reading Achievement, and Figural-De-Centration Measures*

If word recognition and reading achievement involve perceptual de-centration we should expect some degree of communality between measures of them and nonverbal measures of the underlying ability. Our factor analysis did indeed show such a communality. Further, the most parsimonious and still useful interpretation of our results is that factors peculiar to the verbal and figural measures represent differences in experience with the kinds of materials in question.

The coefficients of Table 3 show (*a*) that the requirement of a positive manifold is met, (*b*) that the general factor is relatively prominent, and (*c*) that the approach to an hierarchical order is close. The variation of the triads is no greater than one would expect by chance in a sample of 180 subjects on the assumption of one factor. Not one of the residuals is significant at the .05 level. In fact, the average residual is smaller than the average standard error for residuals; hence the hypothesis that all the measures involve primarily a single process is supported.

The multifactor analysis, although it changes the emphasis, adds to the foregoing interpretation. The unrotated first centroid accounts for nearly 82 per cent of the common variance (including that due to the sex difference). When the variance is distributed by rotation, the four tests involving (primarily) language content and the two tests involving (primarily) figural content give factors distinct from the dimension involving the visual analysis and implicit manipulation of a verbal or figural pattern. Although the varimax simple structure is not good, the first factor implies differences in language skill—differences that might be closely related to differences in amount of experience or "familiarity" with words. The third factor implies a similar kind of difference for figural materials; and young males are evidently more experienced in these tasks than are young females. On the other hand, the second factor comes closest to representing a perceptual operation that transcends differences in test content and that remains as a dimension of individual differences after the variance associated with the two "skill" factors is partialled out by rotation. It seems, then, that both the hierarchical and multifactor methods support the hypothesis of a single factor common to the verbal and nonverbal perceptual tests used in the present investigation.

The factor-analytic solutions are in keeping with Piaget's implicit view of the structure of mental ability. Despite the fact that Piaget eschews the correlation of performances on his different tests (on the grounds that success on one is no indication that the child has mastered the other) Piaget, nevertheless, uses the child's performance on any particular task as a basis for inferring the child's general level of mental development: preoperational, concrete operational, or formal operational. Such an approach to mental assessment is compatible with Spearman's conception of a common *g* factor and particular "S" factors for intellectual tasks. The factor-analytic models of this study suggest an approach for integrating Piaget's findings with those of differential psychology and of bringing together normative and diagnostic approaches to mental measurement.

A possible objection to our interpretations is that the intercorrelations among the variables of the present study can be explained as easily by a general-intelligence factor as by a de-centration factor, so that the postulation of a de-centration factor is superfluous. While we can agree that de-centration may be one aspect of general intelligence, we cannot agree that "de-centration" is an unnecessary construct. It would be unnecessary if the definition of intelligence were more than empirical and if it said something about the nature of the mental processes involved in intelligence-test performance. The explanation of our results in terms of general intelligence, however, adds nothing to one's understanding of mental functioning.

De-centration is a theoretical construct with a meaning that can be used in test construction to predict the kinds of tests that will correlate with each other. De-centration may be part of general intelligence, but it goes beyond the implications of that term and specifies the nature of the mental processes measured by some intelligence scales. In short, the postulation of a de-centration factor operating in reading is not meant to supplant but rather to elucidate the intelligence factor operating in that intellectual achievement.

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COMPARISON OF A PROJECTIVE AND A NON-PROJECTIVE ASSESSMENT OF PARENT ATTITUDES*

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A. INTRODUCTION

With the increasing interest shown by child psychologists in identifying antecedents of personality development in children, research attention has focused appropriately on various aspects of the parent-child relationship. Parent *behavior* (as implied by Freudian theory) in various child-rearing practices has not proved useful as a predictor of the child's later personality or adjustment. Perhaps partly for the foregoing reason, attention has turned to the influence on the child of parent *attitudes* toward the child and toward child rearing. While the precise manner in which parental attitudes operate to affect the child's behavior and adjustment has never been made explicit, it is assumed that a basic, underlying parent attitude influences a wide variety of specific parent behaviors that in their turn bear some causal relation to the child's personality development. Although eventually research may show that the parent's *personality* is more closely linked to the child's personality development than are either parent behavior or parent attitudes, research results to date are meager and difficult to interpret.

Measurement of parent attitudes has a considerable history, dating back at least two decades. During these two decades, psychologists and others have assessed a wide variety of dimensions ranging from rather specific attitudes to fairly general ones. As a result of factor analyses of several parent-attitude scales and of agreement among a number of studies, we are able to draw some conclusions regarding the most significant parent-attitude dimensions. A factor-analytic study (17, 18) of the Parent Attitude Research Instrument (PARI) developed at the National Institute of Mental Health (12, 13) has revealed two major factors: Factor A, Authoritarian-Control; and Factor B, Hostility-Rejection.

Despite its construct validity, the PARI has failed to discriminate among various subgroups of mothers. Several studies (3, 17) have reported no significant differences between the attitudes of mothers of schizophrenics and the

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mothers of normals. Other investigations have shown that the PARI does not differentiate significantly between the attitudes of parents of well-adjusted and poorly-adjusted first graders (8); nor among the attitudes of mothers of children with functional speech articulatory problems, mothers of children with delayed speech development, and mothers of a group of nonspeech-impaired children (9); nor among mothers of asthmatic children, mothers of chronically ill children, and mothers of healthy children (6).

The fairly consistent failure of the PARI to exhibit differences among mothers of children varying widely on important psychological dimensions may be due to the fact that there are, indeed, no significant differences among mothers in their attitudes toward their children and toward child rearing. Ausubel's observation (2, p. 362) that there is a wide margin of safety with regard to parent attitudes may be correct. It may be only when parental attitudes deviate markedly from the typical that they exert harmful effects on the child's behavior and adjustment.

An equally plausible explanation for the failure of the PARI to differentiate among subgroups of mothers is the lack of information concerning the validity of the scale. There are no data showing the relation between a parent's scores on the PARI and parental behavior.

It is apparent that tapping parent attitudes directly is not a simple task. The current emphasis on the crucial effect of parent attitudes toward the child on the child's adjustment has made parents highly sensitive and defensive about revealing their attitudes. Because paper-and-pencil tests that involve relatively obvious items for assessing parent attitudes seem not to be useful, more subtle and disguised approaches are needed. The present paper is a report of a methodological study designed to examine the relation between scores obtained by a group of mothers on the two major factors of the PARI and scores on similar dimensions derived from stories elicited by projective pictures depicting parent-child interactions.

Little has been published on the use of projective techniques to assess attitudes of parent toward children and toward child rearing. Sigel and Hoffman (14), writing in a symposium concerned with the use of projective techniques for the assessment of nonclinical populations, describe a 13-card TAT-type test designed to elicit responses in the area of parent-child relations. These investigators report a high degree of success in predicting from projective protocols the influence techniques a parent employs. Jackson (4) used a series of 11 statements of hypothetical situations involving children as a projective medium. Parents were asked what they would do if they found themselves and their children in specified situations. The responses were scaled on a continuum from "little pressure to conform" to "great pressure to conform." Morgan and Gaier (10) developed a series of 10 picture cartoons depicting situations that might culminate in the child receiving punishment from the parent. The parents were asked to state with regard to any given situation whether or not it had ever occurred in their experience, how the parent and child might be expected to act when it happened, and how as parents they felt about it. Morgan and Gaier note that "pictorially, the cartoons are designed to be as unambiguous as possible to ensure that the subject will interpret them as having punishment implication" (10, p. 449). This approach may be useful for certain research purposes but, as Kass (5) has suggested, the closer the form and operation of the projective technique is to the behavior under study the less projective will be the material elicited.

While a number of sets of projective pictures—Murray's TAT cards (11), the pictures employed by Sigel and Hoffman (14), and Alexander's Adult-Child Interaction Test (1)—are of value, the Travis-Johnston Projective Test pictures (15) were selected as most appropriate for our purposes. This test was designed for use with children between the ages of 4 and 15 and consists of two sets of free-hand drawings: one for females, one for males. The pictures depict adults of both sexes and children of both sexes in a number of "situations and relationships centering in the important and potentially troublesome areas in the socialization of the child" (15).

B. METHOD

1. *Subjects*

Thirty-three mothers of children under 6 years of age served as subjects. The mean age of the group was 27, with a range from 20 to 39 years. The mothers, on the average, had completed a mean of 13 years of schooling, with a range from 8 to 17 years. On the basis of father's occupations, the families were of the lower middle-income group, although a disproportionate number of the fathers were attending college full or part time. The mean years of school attendance for the fathers was 15, with a range from six to 17 years.

2. *Instruments*

The Parent Attitude Research Instrument (PARI) was given to each mother with the request that she read the printed instructions. Then, she was asked whether or not she had any questions about the instructions or about how the items were to be marked. She was cautioned to complete the PARI alone. The completed form was returned by mail or was picked up by the investigator at a later time. All forms were returned. The forms were scored according to Zuckerman's instructions (18). Individual scale scores for Factors A (Hostility-Rejection) and B (Authoritarian-Control) were summed to give complete factor scores.

Eight cards selected from the original 18 of the Travis-Johnston Test were administered to the subjects individually in the following order: 7M, 10M, 16M, 17M, 20M, 27M, 31M, and 32M. The mothers were instructed to make up a story about the picture and to tell what happened before and what might happen after the scene depicted. If a description only was given, the *S*s were reminded to make up a story; and, when appropriate, they were asked what preceded or followed the incident. There was no other probing. Responses were recorded verbatim.

3. *Scoring*

Because no scoring system accompanied the original publication of the Travis-Johnston Projective Test, the authors found it necessary to develop a scoring procedure. We used as a model the detailed procedure for scoring protocols given to TAT-type pictures described by McClelland, Atkinson, Clark, and Lowell (7). Most methods of interpreting projective material deal with the content of the responses or with the forms of the stories that the subject tells. McClelland *et al.* concentrate on the content variables that include the thema or central elements of plot in each story. Specifically, McClelland *et al.* score stories for signs of achievement motivation only and then only on certain carefully designated categories of responses. Because our purpose was to compare the subjects' scores on the two PARI factors with their attitudes as revealed by the projective technique, we used the original descriptions of the scales (12) comprising each factor as the basis for the scoring criteria of the protocols.

Members of a graduate class in advanced child psychology served as judges. Judges were instructed to read the first story for each subject and to score each story for the 13 criteria one at a time. For example, the judges were asked to read Story No. 1 for the first mother and to look for signs of the criterion "A1-a," Breaking the Will. Next, the judges were to look for indications pointing to attitudes concerning "A1-b," Excluding Outside Influences. After the story was examined for all 13 criteria, the judges turned to the first story for the second mother.

After scoring the stories on each of the 13 criteria, the judges were asked to make a global rating for each subject on the two PARI factors, using a five-point scale. For this rating, the judges read all eight stories for a single subject and then rated the mother on the five-point scales for Authoritarian-Control *vs.* Democratic attitudes and for Hostility-Rejection *vs.* Acceptance.

To check on the reliability of the scoring and rating, one of the authors (Mead) scored all the protocols and made global ratings for each subject and compared his results with those of the student judges. When Mead and a judge scored a given item as present, an agreement was tallied. The sum of agreements and disagreements were divided into the number of agreements, and the quotient was multiplied by 100 to yield the per cent of agreement. A comparable formula was used to determine the reliability of the ratings but, in this case, an agreement was tallied when both Mead and a judge rated a parent as above average or below average on the five-point scale.

C. RESULTS

1. *Score Reliability*

Per-cent-of-agreement figures for the scores were 18.4 and 16.0 for the Authoritarian-Control and Hostility-Rejection factors respectively. For the ratings the per cents were 58.3 and 77.7. Although it is apparent that inter-rater reliability was not high for either the ratings or the scorings of the Travis-Johnston test protocols, the authors decided to use Mead's ratings to compare the results of the Travis-Johnston projective material with the scores obtained on the Parent Attitude Research Instrument.

2. *Comparison of the Travis-Johnston Test Ratings and the PARI Scores*

Scores falling above or below the median for Factor A on both measures were tallied in a two-by-two contingency table. Chi square was computed and found not to be significant. See Table 1.

The data for Factor B (see Table 2) indicate that mothers who scored high on the Hostility-Rejection factor in the PARI were also rated high on the Travis-Johnston test protocols. This relation is significant at the .05 level.

TABLE 1
COMPARISON OF PARI SCORES WITH TRAVIS-JOHNSTON TEST RATINGS FOR FACTOR A*

PARI scores	Travis-Johnston scores High authoritarian	 Low authoritarian	Total
High authoritarian	12	4	16
Low authoritarian	8	8	16
Total	20	12	32

* $\chi^2 = 1.2$, $df = 1$, ns.

TABLE 2
COMPARISON OF PARI SCORES WITH TRAVIS-JOHNSTON TEST RATINGS FOR FACTOR B*

PARI scores	Travis-Johnston scores Low hostility rejection	Travis-Johnston scores High hostility rejection	Total
Low hostility rejection	9	5	14
High hostility rejection	2	11	13
Total	11	16	27

* $\chi^2 = 4.80$, $df = 1$, $p < .05$.

D. DISCUSSION

With regard to Factor A, since the subjects who scored high for Authoritarian-Control on the PARI also scored high for this variable in the projective material, it would appear that those mothers who are willing to express authoritarian attitudes on a paper-and-pencil inventory clearly reveal these same attitudes on a test of a projective nature. On the other hand, since subjects scoring low for this variable on the PARI were evenly distributed above and below the median on the Travis-Johnston test, one might speculate that at least some of the mothers in the PARI low-authoritarian and Travis-Johnston high-authoritarian cell in Table 1 scored low on the PARI because of defensiveness. The projective test tapped attitudes at a deeper, less conscious level than did the paper-and-pencil test.

The relatively subtle assessment of Factor B, Hostility-Rejection, by the PARI may account for the significant relation found between the two measures for this factor. The three scales comprising the factor are Marital Conflict, Irritability, and Rejection of the Homemaking Role.

The fruitfulness of attempts to relate parent attitudes to various child behaviors may be increased if the discriminative power of techniques employed to assess these attitudes is increased. Because defensiveness or "unwillingness to reveal certain facts about oneself" undoubtedly operates to influence paper-and-pencil test scores, it would seem fruitful to develop a method in which a clinical measure of defensiveness is applied as a corrective factor to scores obtained on the PARI. The present findings suggest that this would be particularly appropriate for the Authoritarian-Control factor.

E. SUMMARY

An attempt was made to explore the use of a projective technique to evaluate parental attitudes toward children and child rearing and to compare the results of that technique with those of a widely used paper-and-pencil test of parent attitudes: namely, the Parent Attitude Research Instrument.

Thirty-three mothers of children 6 years of age or younger were individually given an eight-card projective test. The mothers were asked to make up a story for each card, and their responses were recorded verbatim. Following the projective test the mothers were asked to complete the Parent Attitude Research Instrument.

Two main variables elicited by the PARI were studied: Factor A, Authoritarian-Control attitudes; and Factor B, Hostility-Rejection attitudes. Scoring criteria for the two factors were developed to facilitate scoring of the projective protocols. In addition, for each of the two variables, the protocols were rated on a five-point scale. Graduate students served as judges. Their scores and ratings were compared with those of one of the investigators (DEM) as a check on the reliability. Per cent agreement was low for the scoring criteria; therefore only the ratings were used in comparing the results of the two tests. While no statistically significant relation was found for the two assessment techniques on Factor A, a significant relation was obtained for Factor B. Several suggestions for further research were discussed.

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THE EFFECTS OF PRENATAL AND NEONATAL COMPLICATIONS ON THE DEVELOPMENT OF PREMATURE CHILDREN AT TWO AND ONE-HALF YEARS OF AGE*[1]

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A. PURPOSE

Prematurity has been reported to be one of the known causes of poor mental and motor development (3, 6, 7, 14). In previous studies of a group of premature children (3, 4), the authors have reported a poorer 12-month and 30-month mental and motor development in comparison with those for a group of full-term children who came from a similar socioeconomic background. It has been a matter of controversy, however, whether or not deficits in development are associated with prenatal and neonatal complications to which premature children have been subjected. Some investigators have found that even in the absence of prematurity there appears to be an association between impaired development and paranatal complications, depending upon the severity of the complications (13, 14, 15). Other investigators have failed to show any significant differences in *IQ* in prematurely born children between normal and paranatally complicated groups, with the possible exception of toxemia and caesarean section (5).

The purpose of the present anterospective study is to investigate the relationship between prenatal and neonatal complications and *IQ* and gross motor and perceptual-motor development at 30 months of a group of prematurely born Negro children, as compared with those for a sample of full-term children.

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B. METHOD

1. *Subjects*

The subjects of this study were premature, single-birth, Negro infants (weighing up to 2100 grams) admitted to Kings County Hospital Premature Nursery between October, 1956, and June, 1959. Of the total number of premature children discharged from the nursery, 252 were examined at two and one-half years of age (Table 1).

TABLE 1
DISPOSITION OF FOLLOW-UP SAMPLE OF PREMATURE AND FULL-TERM CHILDREN

	Children[a]			
	Premature		Full-term	
Type of case	Males	Females	Males	Females
Potential follow-up group	157	183	26	24
Lost				
Died[b]	9	6	0	0
Out of town	16	23	0	0
No information	20	14	14	4
Total not examined	45	43	14	4
Examined at 2½ years				
In data analysis[c]	106	132	12	20
Excluded from data and overage	2	1	0	0
Intervening complications	4	7	0	0
Total	112	140	12	20

[a] The mean chronological age of the full-term children was 125 weeks; that of the prematures (after the correction was made for prematurity), 126 weeks.

[b] Of those children who died subsequent to discharge from the nursery, only one was known to have cerebral palsy. Attempts were made to bring in all children when they were between 30-33 months of age.

[c] Data for children between 33.5-40.0 months of age were included only for the *IQ*-data analysis.

Although the newborn infants were selected randomly, data on the premature children who subsequently incurred lead intoxication, subdural hematoma, or meningitis were excluded because the foregoing complications are known to cause brain damage.

A comparison group of 32 full-term, Negro, single births from the original study was examined at 30 months. These infants weighed more than 2500 grams at birth and were the products of normal labors and deliveries. None of these children was reported to have suffered any of the infections or complications just mentioned, nor did any of them show neurological signs at 30 months. These children came from the same ethnic background and the same underprivileged socioeconomic stratum (17), thereby eliminating variables other than prematurity and its associated paranatal complications. Determination of social class at birth was based on Warner's scale (16).

2. *Determination of Degree of Prematurity*

The degree of prematurity was derived from birth weight and has been described more fully in a previous report (3). Many mothers had never attended the prenatal clinic; so information upon which to determine gestation periods was not obtainable. A regression curve of the length of gestation against birth weight was obtained for all live, Negro, single-birth infants born at Kings County Hospital between 1952 and 1958. Separate curves for boys and girls were obtained. In the birth-weight range up to 2100 grams, no significant differences were found. The correction for prematurity (Table 2) had the effect of minimizing differences in standardized scores between premature and full-term children.

TABLE 2
AGE CORRECTION FOR PREMATURITY

Birth weight (in grams)	Number of months deducted
Less than 1000	3.0
1001-1220	2.5
1221-1550	2.0
1551-1880	1.5
1881-2100	1.0

3. *Prenatal and Neonatal Complications*

The prenatal complications related to the 30-month psychological scores are prolonged rupture of membrane prior to delivery, fever during labor, toxemia, and hemorrhage during labor. The neonatal complications are nonerythroblastic hyperbilirubinemia, per cent weight loss, hypoxia, infection, and low body temperature. Definitions, criteria, and methods used in evaluating the paranatal complications have been described in detail in previous studies (3, 12).

4. *Psychological Tests*

A battery of tests grouped into three categories—intelligence, perceptual-motor development, and gross-motor development—was administered by the psychologists. To eliminate the possibility of bias in the psychological testing, examinations were conducted independently of those of the physician and social worker and without knowledge of previous medical, neurological, and psychological findings.

a. Intelligence test. The Cattell Infant Intelligence Scale (CIIS) was administered as an overall 30-month test of intelligence. In scoring the CIIS, the chronological age was calculated to the nearest tenth of a month from date of birth; and a correction was made for prematurity, as suggested by Gesell and Amatruda (9), to obtain a true maturational age.

b. Picture-vocabulary test. Picture vocabulary, a subtest of the CIIS was selected because the authors thought the test might be a sensitive measure of brain damage at 30 months.

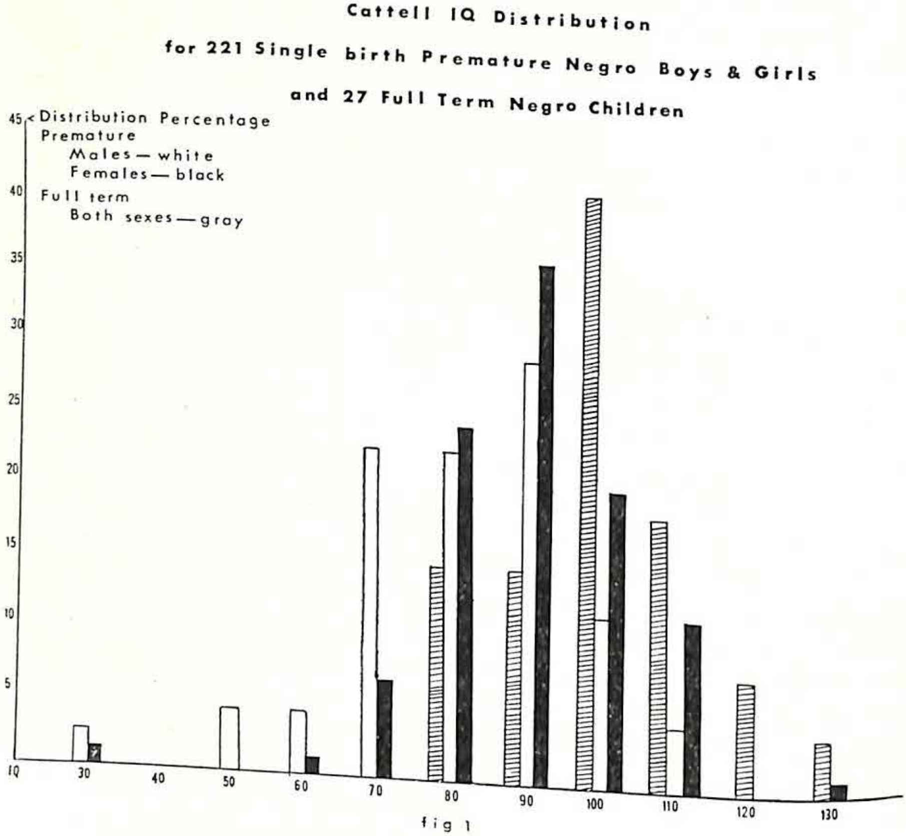

FIGURE 1
CATTELL *IQ* DISTRIBUTION FOR 221 SINGLE-BIRTH PREMATURE NEGRO BOYS AND GIRLS AND 27 FULL-TERM NEGRO CHILDREN

c. Perceptual-motor tests. The Wallin Peg Board B and Tower Building tests were taken from a lower level of the CIIS. The peg-board test was modified by timing the speed with which the child could accurately place the square pegs in square holes. Tower building, an untimed test, was scored by counting the number of blocks the child was able to stack; age correction was made for prematurity.

d. Gross-motor test. A modified gross-motor test (Table 3), with items taken from Gesell Schedule (9) and Bayley's Scale of Motor Development (1, 2) was administered. In scoring, correction was made for prematurity.

5. *Neurological Examination*

Heimer (10, 11) gave all the children a physical and standardized neurological examination. A four-point scale (ranging from zero to three) was

TABLE 3
GROSS-MOTOR SCALE

Performance tasks	Score
Seats self in small chair.	1
Walks and stops, deviant (specify).	1
Squats in play.	1
Kicks or walks into large ball:	
Walks.	1
Kicks.	2
Walks upstairs:	
Cannot climb stairs.	0
Any method except those listed.	1
One hand held.	2
Holds rail, marks time.	3
Holds rail, alternates feet.	4
No support, marks time.	4
No support, alternates feet.	5
Other (specify). Score as appropriate.	
Walks downstairs:	
Cannot climb stairs.	0
Any method except those listed.	1
One hand held.	2
Holds rail, marks time.	3
Holds rail, alternates feet.	4
No support, marks time.	4
No support, alternates feet.	5
Other (specify). Score as appropriate.	
Jumps from bottom stair.	1
Stands on one foot:	
One hand held.	1
Alone, momentary.	2
Alone, two seconds or over.	3
Aufstehn:	
Rolls completely over onto stomach before pushing up.	1
Turns to one side and pushes up.	2
Pulls self forward (with little or no sidewise turning) to sitting position and then stands.	3
Rides tricycle:	
Gets on by self.	1
Reverses pedals (one half revolution).	2
Rides adequately.	

based on the diagnosis of no neurological abnormalities, possible, probable, or definite neurological abnormalities.

6. *Analysis of the Data*

The psychological data were analyzed separately for the premature boys and girls because of significant sex differentials in performance (favoring the girls) found at one year of age (3, 8, 10, 11). No significant differences were found between the scores of the full-term males and females; so the scores for full-term babies were pooled.

The effect of neurological status was partialled out because of the high correlation between test scores and neurological impairment and because, in a previous study (10, 11), neurological impairment at two and one-half years was found to be related to birth weight. The relationship between the prenatal and neonatal complications and neurological impairment was found to be due to the tendency for children of low birth weight to show these complications and also to develop neurological impairment. No direct relationship between the complications and the neurological impairment was apparent.

The high correlation of the picture-vocabulary test with the overall *IQ* score (Table 4) and the poorer relation of picture-vocabulary scores with the paranatal complications and the neurological impairment make untenable the hypothesis that the picture-vocabulary test is an independent sensitive measure of brain damage at 30 months.

C. RESULTS

1. *Relationships Among the Psychological-Test Scores for the Premature Children*

The interrelations of the psychological scores for this group shows that there are significant, positive correlations between *IQ* scores and gross-motor and perceptual-motor tests. In general, the gross-motor tests correlate significantly with all other tests. Only among the premature boys is the correlation between gross-motor scores and the peg-board scores not significant (Table 4).

The two perceptual-motor tests were found to be independent of each other, indicating that they measure different visuo-motor functions.

2. *The Relationship Between Psychological-Test Scores and Neurological Diagnosis at 30 Months*

All the psychological-test scores correlate significantly with the neurological-diagnostic ratings. The comparison of the mean psychological scores

TABLE 4

Pearsonian Correlation Coefficients Among the Psychological Tests of Premature Males (M) and Females (F)†

	Test							
	Gross motor		Peg board		Tower building		Picture vocabulary	
Test	M	F	M	F	M	F	M	F
IQ	.696**	.466	—.215*	—.263**	.600**	.148**	.702**	.715**
Gross motor			—.155	—.300**	.574**	.368**	.485**	.389**
Peg board					—.049	—.061	—.180	—.223**
Tower building							.358**	.119

† There were between 75 and 90 paired observations for the males and between 106 and 114 paired observations for the females. The variation in N is due mainly to the exclusion of unstandardized test scores for children observed when more than 33 months of age and because all the tests were not available for all children.

* $p < .05$, two-tailed test.

** $p < .01$, two-tailed test.

of the neurologically intact children with that of the impaired children shows, as anticipated, that the neurologically normal children have significantly higher scores on the CIIS, gross-motor tests, and the visuo-motor tests than do the neurologically damaged children (Table 5).

3. *Differences in Performance on the Psychological Tests Between the Male and Female Premature Children*

a. Cattell scale. There is a significant difference between the mean *IQ* of 95 for the total group of premature girls and that of 86 for the premature boys ($t = 4.64$, $p < .001$). A further analysis, comparing the children with no neurological abnormalities, shows a significant difference between the mean *IQ* of 95 for the girls and that of 91 for the boys ($t = 2.25$, $p < .05$).

b. Gross-motor test. There is no significant difference between the mean gross-motor score for the total group of premature males and that of the total group of premature females ($t = 1.69$).

c. Perceptual-motor tests. For the neurologically intact boys and girls, no significant sex differences were found.

4. *Relationship Among the Psychological-Tests Scores, Birth Weight, and Paranatal Complications in the Premature Children*

a. Cattell scale. There is no significant association between birth weight and the mean *IQ* for the premature children at 30 months of age (Table 6). The correlations between the mean *IQ* of the premature children and the scores representing prenatal and neonatal complications show only two significant and low negative correlations: (*a*) *IQ* and toxemia in the mothers (for both sexes) and the presence of a history of toxemia being associated with lower *IQ* and (*b*) correlations between *IQ* and other prenatal complications, such as prolonged ruptured membranes, fever during labor complications, are not significant.

Correlations between *IQ* and the neonatal complications, peak serum bilirubin level, and percentage weight loss, low body temperature and infection are in the expected directions; although not statistically significant. There is a significant correlation between the hypoxia score and *IQ* for the girls, but this correlation is not significant when neurological scores are partialled out ($r' = -.145$).

b. Perceptual-motor tests. The timed peg-board test scores do not correlate significantly with any of the paranatal complications in the premature boys and with toxemia only in the premature girls. When neurological scores are

TABLE 5

Comparison of Mean Psychological Test Scores According to Neurological Diagnosis, Sex and Prematurity*[a]

Diagnostic group	Test														
	IQ			Gross-motor			Peg board			Tower building			Vocabulary		
	N	*M*	t^b	*N*	*M*	*t*	*N*	*M*	*t*	*N*	*M*	*t*	*N*	*M*	*t*
Premature boys															
Normal	70	91		64	16.7		63	37.7		67	6.5		67	5.4	
Abnormal	27	74	5.6**	23	11.5	6.6**	18	47.4	2.0*	24	4.8	3.8**	25	2.1	3.3**
Premature girls															
Normal	110	95		98	16.9		100	39.8		102	6.8		106	6.2	
Abnormal	14	89	1.8	14	11.6	5.7**	11	55.0	2.7**	12	5.7	0.9	14	4.4	1.6
Boys															
Premature	70	91		64	16.7		63	37.7		67	6.5		67	5.4	
Full-term	12	103	4.2**	10	19.0	3.7**	12	31.1	0.7	12	7.9	1.8	12	8.0	2.5*
Girls															
Premature	110	95		98	16.9		100	39.8		102	6.8		106	6.2	
Full-term	20	103	2.8**	15	19.9	3.6**	17	37.2	1.4	19	6.9	1.1	16	7.8	1.7

[a] No significant differences were found between the scores of the full-term males and full-term females; therefore the scores were pooled in the calculations.

[b] The *t* test was used to compare the mean scores of the premature boys and girls. In comparing the premature children with full-term children, the Tukey-Kramer method was used.

* $p < .05$.

** $p < .01$.

TABLE 6
PEARSONIAN CORRELATIONS BETWEEN PSYCHOLOGICAL TESTS, PRENATAL AND NEONATAL COMPLICATIONS, BIRTH WEIGHT, AND 30-MONTH NEUROLOGICAL DIAGNOSIS

	Test									
	IQ		Picture vocabulary		Peg board		Tower building		Gross-motor	
Variable	M	F	M	F	M	F	M	F	M	F
Prenatal complications										
Prolonged rupture of membranes	—.062	.063	—.105	—.051	.046	—.005	.094	—.126	.033	.009
Fever during labor	.046	.001	.031	—.139	—.061	.149	—.110	.076	.022	.046
Toxemia	—.218*	—.184*	—.178	—.044	—.180	.239*	.236*	.088	—.258*	—.003
Hemorrhage during labor	.002	—.054	.047	—.141	—.061	.008	.234*	—.006	—.211	—.118
Neonatal complications										
Peak serum bilirubin	—.078	—.002	—.091	—.017	—.158	—.009	—.165	.082	—.156	—.067
Per cent weight loss	.081	—.070	.041	—.105	.044	—.109	.027	—.062	.018	—.080
Hypoxia score	.152	—.208*	.079	—.256*	—.097	.049	.085	—.133	—.024	—.246*
Low body temperature	.184	—.150	.082	—.180	—.070	.099	—.009	—.039	.055	—.072
Infection	.142	—.100	.158	—.100	—.129	—.110	.046	—.150	—.129	—.313**
Birth weight	.142	.119	.190	.332**	.015	—.155	.301**	.195*	.263*	.331**
Neurological diagnosis at 30 months	—.574**	—.290**	—.342**	—.134	.231*	—.205*	—.471**	—.258**	—.586**	—.517**

* $p < .05$, two-tailed test.
** $p < .01$, two-tailed test.

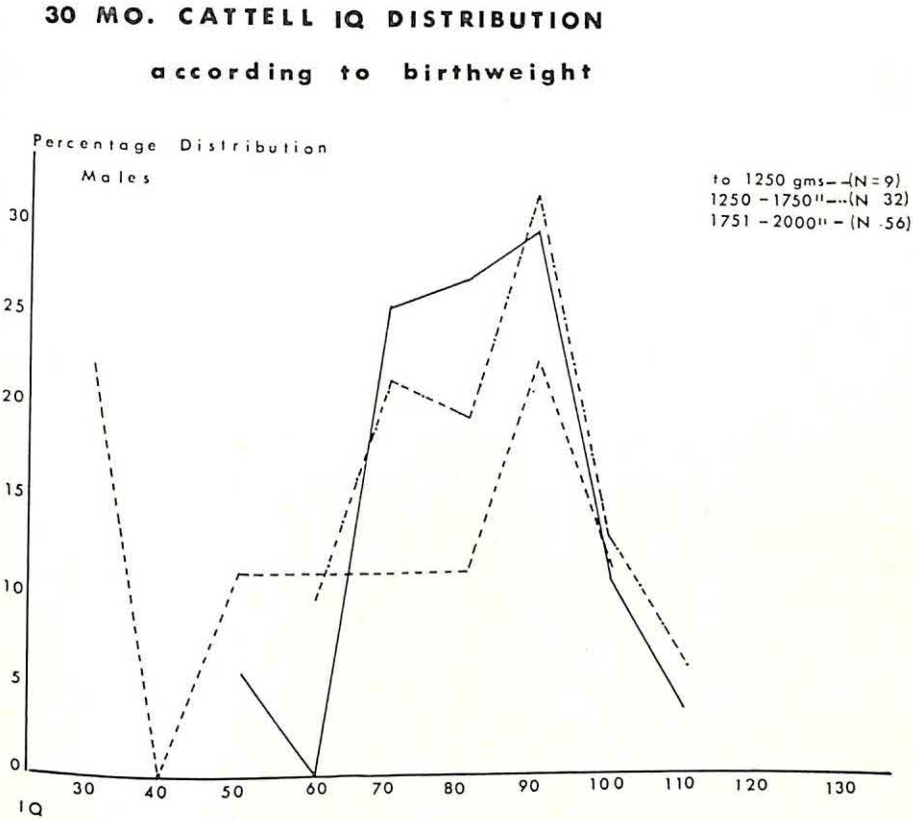

Fig 2

FIGURE 2
30-MONTH CATTELL *IQ* DISTRIBUTION ACCORDING TO BIRTH WEIGHT

partialled out the partial correlation ($r' = .238$) remains significant ($p < .05$) and indicates that girls who show no overt signs of neurological abnormalities (but whose mothers had toxemia) do less well on this test than do the other neurologically normal girls ($t = 2.2$, $p < .05$).

Between the tower-building test and paranatal conditions there are only four low (but significant) correlations: toxemia, hemorrhage during labor, and birth weight for the males; and birth weight for the females. None of the relationships between the prenatal and neonatal complications and the tower-building scores remain significant when the neurological scores are partialled out with one exception: namely, the history of hemorrhage during labor in the premature boys ($r' = -.197$, $p < .05$).

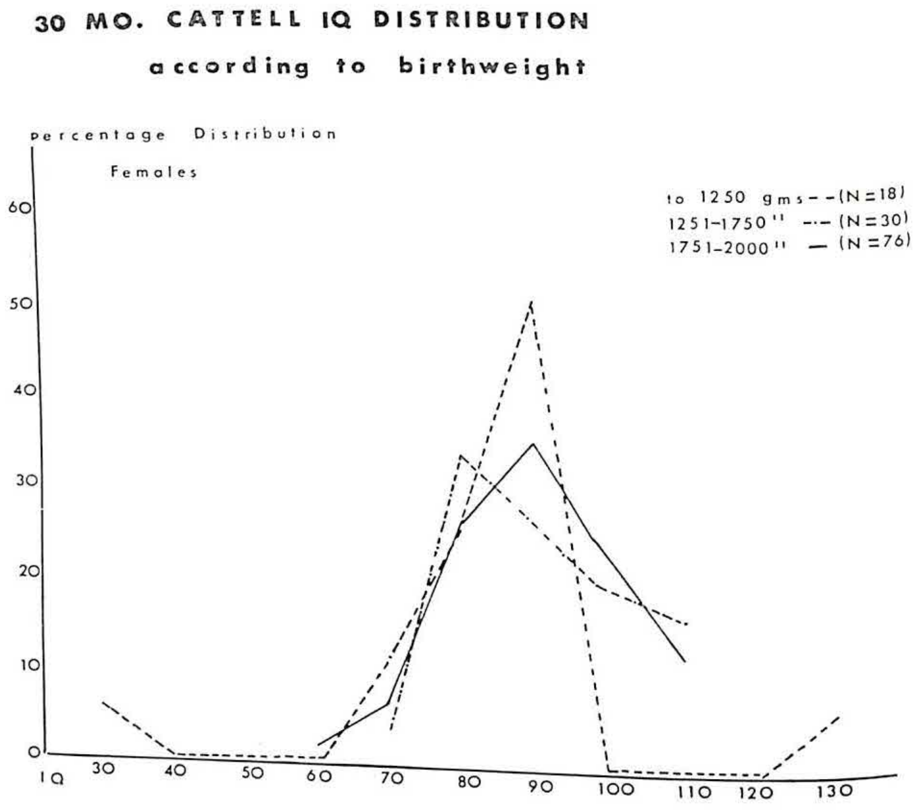

Fig 3

FIGURE 3
30-Month Cattell *IQ* Distribution According to Birth Weight

c. Gross-motor test. In the premature boys, positive correlations were found between gross-motor scores and birth weight and toxemia. Neither of these complications is associated with lower gross-motor scores when neurological diagnosis is partialled out ($r' = .062$, $r' = —.089$).

For the premature girls, there is a significant relationship between gross-motor performance and birth weight, infection, and hypoxia. Unlike the case for boys, when neurological scores are partialled out, the correlations with birth weight and with infections remain significant ($r' = .282$, $p < .01$, $r' = —.182$, $p < .05$, respectively). The correlation between the gross-motor scores and hypoxia are not significant when neurological scores are partialled out ($r = —.150$).

5. *Comparison of the Mental and Motor Development of the Premature Children with those of the Full-Term Children*

a. Cattell intelligence scale. The mean *IQ* scores of the premature males and females without overt neurological signs at 30 months show a significant depression of scores in comparison with those of the full-term group (males: $t = 4.18$, $p < .01$; females: $t = 2.83$, $p < .01$).

b. Perceptual-motor tests. There are no significant differences between the scores for the neurologically intact premature males and females and the full-term children (peg board—males: $t = .095$, females: $t = 1.35$; tower building—males: $t = 1.75$, females: $t = 1.02$).

c. Gross-motor scale. The mean gross-motor scores of 16.7 for the intact premature boys and 16.9 for the premature girls are significantly lower than the mean score of 19.6 for the full-term children (boys: $t = 3.7$, $p < .005$; girls: $t = 3.6$, $p < .005$).

D. DISCUSSION

In assessing the 30-month intellectual, perceptual-motor and gross-motor development of a group of premature children, it appears that (in general) neurological abnormality is the major factor contributing to impaired performance. A previous report showed that neurological impairment occurs more frequently in the lowest-weight prematurely born children. It is understandable, therefore, that those paranatal complications that are not associated with low birth weight and coincident with neurological impairment are those that do not correlate with the psychological scores since it was the presence of neurological impairment which had the greatest effect on the scores.

Among the premature girls, there are significant associations between scores on one of the perceptual-motor tests (timed peg board) and toxemia, and between gross-motor scores and neonatal infection and hypoxia, independent of neurological impairment. However, there are also lower gross-motor scores related to low birth weight and independent of neurological impairment. As neonatal infection and hypoxia correlate with low birth weight, it may be that the depression of scores in association with these complications is due to low birth weight, low birth weight being the expression of those factors associated with premature birth not evaluated as paranatal complications. One cannot determine from this study, therefore, whether it is the complications measured or low birth weight or a combination of these factors that relate most meaningfully to depression of test scores in the neurologically normal girls. In the light of the marked depression of scores in the neurologically impaired children and the fact that these impaired children tended to be those of low birth weight, it is conjectured that lower scores related to neonatal complications and low birth weight may represent minimal brain damage not apparent in overt neurological abnormalities.

As it has been shown that there is no consistent relationship between paranatal complications and the development of neurological abnormalities in either sex, a history of these complications in this group of children was of little prognostic value for mental and motor development at 30 months. It appears, then, that there are factors other than the complications evaluated in this study that contribute to the poor performance of these premature children. This would certainly appear to be true when one compares the prematurely born boys with the prematurely born girls. Both the higher incidence of neurological abnormalities among the premature boys and their lower *IQ* scores, even in the absence of neurological impairment, cannot be accounted for by a greater incidence of either the prenatal or neonatal complications, but can best be explained as a manifestation of their greater biological vulnerability.

Children born prematurely, whether or not they are overtly neurologically damaged show a lag in development in comparison with that of the full-term group. Any differences found in psychological scores between the neurologically normal premature children and the full-term children cannot be attributed to differences in socioeconomic status. Furthermore, the differences in unstandardized tests cannot be due to age differences (Table 1). One should note that by using the corrected chronological age the *IQ* scores of the prematurely born children are increased, so that differences in favor of the full-term children are minimized.

E. Summary

The effect of paranatal complications on the 30-month development of a group of 249 Negro, single-birth, premature children was studied. A comparison group of 32 full-term Negro children was selected on the basis of an uneventful paranatal course and because of similarity in socioeconomic background.

Prenatal complications considered were prolonged rupture of membrane prior to delivery, intrapartum fever, toxemia, and hemorrhage during labor. The neonatal complications considered were hyperbilirubinemia, weight loss, hypoxia, infection, and low body temperature. Other independent variables were sex and birth weight.

Consistent, significant relationships were *not* found between the incidence of paranatal complications and psychological-test scores at 30 months. The depression in mental and motor development associated with low birth weight is due to the high incidence of neurological damage in prematurely born children of very low birth weight. The relationships between depressed scores and the neonatal complications appear to be due to the higher incidence of these complications in infants of low birth weight.

Although the incidence of prenatal and neonatal complications was comparable for the premature boys and girls, there is a significantly higher incidence of neurological abnormalities among the males with a consequent depression in psychological scores.

Children born prematurely, even those without neurological abnormalities, had depressed *IQ* and gross-motor scores in comparison with those of full-term children at 30 months.

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A NOTE ON SCHOOL DROPOUTS IN LONGITUDINAL RESEARCH WITH LATE ADOLESCENTS*

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A. INTRODUCTION

As part of a comprehensive developmental study, Rorschach records were obtained from students attending a college devoted primarily to teacher education.[1] Because three successive annual records were needed for each subject, only those subjects were accepted who agreed to be available for one testing session a year for three years, even if they should drop out of college.

Despite the agreement, many subjects were lost, either because they left school or because they lost interest in the study. At the 1963 spring meeting of the New York Society for Projective Techniques, the question was raised as to whether or not differences appeared between the Rorschach responses of those who dropped out and those who stayed with the study for all three years.

B. SUBJECTS

Initially, 62 boys and 68 girls agreed to serve as subjects for the three years. Of these, 18 boys and 25 girls completed the series. Because of the influence of intelligence on Rorschach scores, each subject who attended all three sessions was matched with a subject who attended only one session. Matching was within five *IQ* points on the California Test of Mental Maturity, as reported by the college. Table 1 shows mean *IQ* scores for the boys and girls and the mean age at the time of the first test. On both variables the matched groups are similar.

Eleven of the 18 dropout boys had left college, four were dropped by the college, three continued in college but refused to participate further in the study. All of the dropout girls had left college.

C. TEST RECORDS

The Rorschach records obtained during the first testing session were scored on the traditional scoring variables (1, 2). Differences between the scores

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* Received in the Editorial Office, Provincetown, Massachusetts, on April 2, 1964.
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[1] Acknowledgment for help is made to the faculty and participating students at Southern Connecticut State College, New Haven, Connecticut.

TABLE 1
MEAN AGE, *IQ*, AND RORSCHACH SCORES FOR MATCHED GROUPS

	Girls		Boys	
Variable	School survivors N = 25	School dropouts N = 25	School survivors N = 18	School dropouts N = 18
Age	18:8	18:6	19:4	19:10
IQ	105.8	107.1	105.0	105.2
Rorschach score				
R	15.8	16.3	15.6	11.7*
Refusals	.2	.2	.2	.8*
W%	61.8	60.9	58.4	55.3
D%	35.8	34.8	38.1	39.6
Dd%	2.2	4.2	3.2	4.7
F%	46.5	49.3	50.3	54.5
F+%	91.6	92.8	91.0	89.9
M	2.0	2.1	2.1	1.8
FM	2.5	3.1	2.0	1.6
m	.8	.7	1.1	.5*
F(C)	1.1	.8	.8	.2*
FC	.3	.2	.3	.3
CF	1.3	1.0	.4	.4
C	.2	.1	.1	0
ΣC	1.7	1.2	.7	.6
A%	49.5	54.4	52.9	55.2
H%	17.7	17.8	19.8	22.0
Number of content categories	5.6	5.3	5.2	3.8*

* Probability that mean difference is zero is less than .05 by *t* test for matched pairs.

of the partners in each matched pair were computed, and mean differences were evaluated for significance. Table 1 shows the mean Rorschach scores for the matched groups.

There were no significant differences between the scores of the girls who continued and of those who dropped out. Five Rorschach variables differentiated the two boys' groups: number of responses, inanimate movement, shading, number of refusals, and number of content categories.

The composite picture suggests that, even when matched for intelligence, the boys who continued in college were more richly productive (R, refusals, content), more sensitive, more tense—and presumably better able to tolerate tension. For the boys, continuing in college may reflect greater success in meeting the developmental tasks of late adolescence.

For the girls the composite picture shows no trends. No Rorschach score showed a significant difference, and the small obtained mean differences tended if anything to depict the dropout girls as brighter and richer in personality. Only a knowledge of why the girls left college could explain the difference. It is tempting to speculate that for these girls of modest ability, marriage represented at least as great a success as continuing in education.

D. SUMMARY

Of 130 college students who agreed to participate for three years in a longitudinal Rorschach study, two-thirds dropped out after the first testing session. After being paired on *IQ* with 18 dropouts, the 18 boys who continued were found to have a higher mean number of responses, higher inanimate movement, higher shading, more content categories, and fewer refusals than those who dropped out of the study. The 25 girls who continued showed no significant differences from those who dropped out. The sex difference implies that success for the boys meant continuing in college, but that success for the girls may have meant something else.

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CHILDREN'S BEHAVIOR PROBLEMS AND PARENTAL ATTITUDES*

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A. INTRODUCTION

The importance of parental attitudes in the origin of children's behavior problems is generally assumed in clinical practice and in many personality theories. In order to document and explore empirically the relationship between parents' attitudes and children's behavior, it has been necessary to find ways of defining and assessing both of these phenomena.

In an attempt to lay the groundwork for fruitful study of the etiology and treatment of children's behavior disorders, Peterson (4) has addressed himself to the task of defining disorders in terms of nonarbitrary, unitary, and independent concepts. By factor-analytic methods, Peterson has shown that two disorders occur with remarkable invariance in various groups of children. He calls one the personality-problem factor (implying an excessive inhibition of impulses); the other, the conduct-problem factor (implying an excessive expression of impulses). To trace etiology, Peterson and his colleagues have attempted to relate the foregoing factors to certain parental characteristics (5), but they have found only a single parental-attitude pattern (assessed by interviewer raters) to be associated with both factors.

Because modern theory and practice stress the importance of parental attitudes in the etiology of children's behavior problems, much effort has been expended in recent years to develop instruments for assessing attitudes about child rearing. The assumed usefulness of an objective questionnaire, and its greater speed and efficiency compared to those of an interview as a means of assessing parental attitudes, led Schaefer and Bell (6) to develop the Parental Attitude Research Instrument (PARI). Although several forms have been constructed,[2] and the various forms have been used in a wide variety of

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[1] The authors wish to thank Mrs. Betty Simon and Dr. Ray Ditrichs for their assistance in collecting and analyzing the data.

[2] One gets the impression that there are almost as many forms of the PARI as there are investigators, and the fact that many investigators fail to identify the form they have used has caused considerable confusion.

research endeavors, attempts to find differences between parents of "problem" children and parents of "normal" children generally have been unsuccessful. For example, Zuckerman, Barrett, and Bragiel (9) have found that PARI scores do not yield marked differences between parents of children seen in a child-guidance clinic and parents of control children, nor are they markedly related to the psychiatric diagnosis of the clinic children.

The purpose of the present study is to investigate the relationship between the professed attitudes of parents of "problem" children and the type of problem manifested by the child. The authors felt that Peterson's problem checklist would furnish a more objective and reliable means of categorizing children's problems than would existing psychiatric diagnoses because there exists divisiveness rather than unanimity regarding psychiatric nosology. The study was also designed to include fathers, as in many studies of parental attitudes only the mothers' attitudes have been investigated.

B. Procedure

Our subjects were 31 children and their parents who were referred to the Child Psychiatry Service of the University of Iowa because of emotional disturbance in the children. On the basis of scores on Peterson's problem checklist, the cases were selected from a larger sample of 62 cases. The 62 cases were a random sample of children referred to the Service during the period from February, 1961, through August, 1962; and who met the following criteria:

1. The child was accompanied by both parents.
2. The parents were the natural parents or, if they were the adoptive parents, the child had to have been adopted before the age of 2.
3. The child had never been placed outside the parental home (e.g., in an institution or foster home).
4. The child was of school age.
5. The child had an *IQ* above 70.
6. The child was not diagnosed as having brain damage.
7. The parents completed the PARI. (Of 65 sets of parents requested to take the PARI, only three persons refused to take it or failed to complete it.)

On the basis of information provided by the parents, the referring physician, the school, and (in some cases) other agencies, such as a court or social-welfare agency, a social worker rated each child on the checklist.[3] For each child, factor scores were computed by unweighted summation over the 15 variables or "problems" making up each of the two factors.

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[3] The help of Mrs. Patricia Kelley, Miss Elham NurEddin, and Mr. Robert Hinshaw, psychiatric social workers who made the checklist ratings, is gratefully acknowledged.

All children with scores above the median personality-factor score and below the median conduct-factor score were selected for the personality-problem group. All children with scores above the median conduct-factor score and below the median personality-factor score were selected for the conduct-problem group. For both groups, an additional stipulation was that the scores on the primary factor exceed by five points scores on the other factor; hence the groups contain children with decided problems of one type but with a virtual lack of problems of the other type.

Seventeen children met the criteria for the personality-problem group, and 14 met the criteria for the conduct-problem group. Of the 31 children, 22 were boys and nine were girls—not an uncommon ratio for child-guidance cases. Ten of the boys were in the personality-problem group; 12, in the conduct-problem group. Seven of the girls were in the personality-problem group; two, in the conduct-problem group—giving a proportion that reflects Peterson's finding that girls rarely have conduct problems. The mean age of the total group of subjects was 11.72 ($SD = 2.98$, range $= 6.08$ to 15.83). The mean age of the personality-problem group was 12.47 ($SD = 2.70$), and the mean age of the conduct-problem group was 10.80 ($SD = 3.05$). The difference between the foregoing means is not significant ($t = 1.56$, $p > .1$).

The PARI form used for the mothers was the form suggested by Zuckerman (8). It contains 13 of the original PARI Form IV scales and Zuckerman's reversed scales for control of the acquiescence response-set. These scales make up two factors described as follows (the number of the original PARI scale precedes the scale name):

Factor A. Authoritarian-Control

1. Harsh Punitive Control
   - (4) Breaking the Will
   - (10) Excluding Outside Influences
   - (11) Deification
2. Suppression and Interpersonal Distance
   - (16) Avoidance of Communication
   - (18) Suppression of Sex
3. Over Possessiveness
   - (2) Fostering Dependency
   - (5) Martyrdom
   - (20) Intrusiveness
4. Excessive Demand for Striving
   - (8) Strictness

(22) Acceleration of Development

Factor B. Hostility-Rejection

(7) Marital Conflict
(9) Irritability
(13) Rejection of the Homemaking Role

The usual and the reversed scores were combined by subtracting the summed scores on the reversed scales from the summed scores on the original scales and by adding a constant to eliminate minus values. Except for Factor B, in which (following Zuckerman's suggestion) Scale 7 received only one-half weight, the scales were equally weighted.

A parallel form of 13 usual scales and 13 reversed-item scales was constructed for the fathers. Nine of these scales consist of items from the Parent Practices Research Scale (1), a scale that contains a modification[4] of Schaefer and Bell's PARI form for fathers (7). These nine scales for fathers are parallel to Scales 2, 4, 7, 8, 9, 10, 11, 16, and 18 for mothers and bear the same names. The modification of Schaefer and Bell's Scale 12, Irresponsibility of Father, was used as a parallel scale to Scale 13 for mothers, Rejection of Homemaking Role. The manifest attitudes expressed in these scales appear to be quite similar. The three remaining scales were made identical to Scales 7, 8, and 10 for mothers—words such as "father" and "he" being substituted for "mother" and "she." By substituting appropriate gender-designating words in Zuckerman's reversed items for mothers, the reversed scales were constructed in similar fashion. Scale scores for the fathers were obtained in the same way as for mothers: i.e., by combining the usual and the reversed scores.

The PARI was given to the parents on the day they first brought their child to the Child Psychiatry clinic. They were told that it was a research questionnaire and that their answers to questions on it would not be considered in evaluating their child's problems.

C. RESULTS

Comparisons of the mean PARI factor scores made by mothers of personality-problem children and mothers of conduct-problem children are shown in Table 1. Comparisons of the mean PARI scale scores made by fathers of the two types of children are shown in Table 2. (Scale scores rather than factor scores were compared because no factor analysis has been done of these 13 scales for fathers.)

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[4] The scales are modified to contain only five items each (paralleling the mother's form), rather than eight items as in Schaefer and Bell's form for fathers (7).

TABLE 1
COMPARISON OF MEAN PARI SCORES OF MOTHERS

PARI factor	Conduct-problem group Mean	Personality-problem group Mean	t
A. Authoritarian Control (total)	113.3	123.5	1.014
A1. Harsh Punitive Control	36.6	39.4	0.626
A2. Suppression and Interpersonal Distance	17.7	19.4	0.698
A3. Over Possessiveness	31.9	31.2	0.215
A4. Excessive Demand for Striving	27.0	33.5	2.495*
B. Hostility-Rejection	43.8	39.4	1.228

* $p < .05$.

TABLE 2
COMPARISON OF MEAN PARI SCORES OF FATHERS

PARI scale	Conduct-problem group Mean	Personality-problem group Mean	t
Breaking the Will (4)[a]	13.43	15.06	1.041
Excluding Outside Influences (15)	14.36	13.06	0.680
Deification (14)	16.21	15.12	0.631
Avoidance of Communication (23)	8.57	8.88	0.227
Suppression of Sex (18)	14.64	12.53	1.555
Fostering Dependency (2)	14.14	12.59	0.894
Martyrdom[b]	12.07	12.24	0.099
Intrusiveness[c]	16.21	14.53	0.959
Strictness (17)	18.00	19.18	0.705
Acceleration of Development[d]	14.86	16.29	0.781
Marital Conflict (7)	19.29	20.59	1.217
Irritability (16)	16.21	14.41	1.056
Irresponsibility of Father (12)[e]	12.36	11.00	0.964

[a] The numbers in parentheses following the scale names refer to the scale number of Schaefer and Bell's form for fathers (7).

[b] Corresponds to Scale 5 on Schaefer and Bell's Form IV for mothers (6).

[c] Corresponds to Scale 20 on the mothers' form.

[d] Corresponds to Scale 22 on the mothers' form.

[e] Similar in content to Scale 13 on the mothers' form.

Because factors such as mother's age, educational level, and husband's occupation have been found to be significantly related to mother's scores on the PARI (9), we compared the parents of the two groups of children in terms of mother's and father's age, mother's and father's educational level, and father's occupation. The results for age and education are presented in Table 3. Differences in father's occupation (blue collar *vs.* white collar) were not found to be significant ($\chi^2 = .0501$, $df = 1$, $p > .8$).

TABLE 3
COMPARISONS OF PARENTS' MEAN AGE AND EDUCATION

	Age			Education		
Parent	Conduct-problem group Mean	Personality-problem group Mean	*t*	Conduct-problem group Mean	Personality-problem group Mean	*t*
Mothers	35.1	41.2	2.56*	11.9	12.4	0.50
Fathers	38.9	44.4	2.32*	12.0	12.5	0.37

* $p < .05$.

D. DISCUSSION

In general, the results indicate that the professed attitudes of parents of children with personality problems do not differ significantly from those of parents of children with conduct problems. The one significant difference obtained implies that mothers of personality-problem children (i.e., the internalizing, overinhibited children) are more excessive in their demands for striving than are mothers of conduct-problem children. However, since this difference is the only one out of 19 that reached the .05 level of significance, it may well be due to chance.

The repeated failure of the PARI to provide meaningful discrimination between various groups of clinic parents and between clinic parents and "normals" implies that the attitudes that it "measures" have little clinical relevance. Of course, it is possible that parental attitudes (no matter how well assessed) are variables not relevant in the psychopathology of the child. A more likely possibility, however, is that it is the parents' attitudes about the particular child in question, rather than their attitudes on the subject of childrearing in general, that are relevant. Gildea, Glidewell, and Kantor (2), for example, have shown that a mother's attitude about her responsibility for her child's behavior is related to the child's adjustment in school.

One must remember that the predictive validity of Peterson's problem factors—despite the demonstrated reliability and widespread applicability of the checklist—has not been firmly established. As Lorr (3) has pointed out, even though the use of factor analysis in classifying behavior disorders has offered much promise, results of many factor studies have been disappointing. One cannot say for sure whether or not the negative results of the present study are due to the predictive failure of Peterson's factors or to that of the PARI.

The findings regarding the age of the parents of the two groups of children imply that Peterson's factors may have some predictive usefulness. The results reported in Table 3 indicate that parents, both mothers and fathers, of personality-problem children are significantly older than parents of conduct-problem children, even though the two groups of children do not differ significantly in age and even though the parents do not differ in educational level. A commonly held notion is that older parents are stricter, less flexible, and more intolerant of misbehavior in their children than are younger parents; hence may be more likely to have overinhibited, internalizing children. It appears, however, that this notion has not been demonstrated empirically. Child-psychology literature is surprisingly devoid of information on the relationship between parents' ages and children's behavior. It is felt that our findings point to an area that merits further investigation.

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CHILDREN'S PAINTINGS AND THE PROJECTIVE EXPRESSION OF PERSONALITY: AN EXPERIMENTAL INVESTIGATION*[1]

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A. PROBLEM

The view that a child projects his personality through his painting has been widely accepted. Alschuler and Hattwick's investigation (1), in particular, has been instrumental in establishing this point of view. The projective-expression hypothesis states that "the feelings and drives which two-to-five-year-old children reflect in their easel painting are also likely to be reflected in their overt behavior" (1, p. 381).

The foregoing hypothesis has not been subjected to careful experimental scrutiny. Bell's review (4), Goodenough and Harris's review (7), and the few studies published since 1950 (3, 10), reveal no investigation that combines (*a*) adequate statistical controls, (*b*) reliable and valid personality measures, and (*c*) judgments of paintings made independently of knowledge about the child's personality (6). The need still exists, therefore, for a careful experimental test of the projective-expression hypothesis (2, 7, 8, 11).

The most relevant test of the hypothesis should focus on the judgmental process—that is, on the ability of a person to perceive similarities and differences between paintings and personality; therefore, we choose to test two null hypotheses: (*a*) there is no discriminable difference between the paintings of normal children and the paintings of emotionally disturbed children; and (*b*) one cannot match a child's paintings to a description of his personality.

B. METHOD

1. *Subjects*

Subjects were 22 boys and girls between the ages of 3 and 5 (the age range studied by Alschuler and Hattwick). They came from middle-class and upper

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[1] We are indebted to Dr. P. M. Reilly for assistance in the statistical aspects of this study.

middle-class families and were in attendance at four nursery schools and kindergartens in Bennington, Vermont, and Baltimore, Maryland.

None of the children was mentally retarded, but 11 of the children were from a school for emotionally disturbed children that, on the basis of test findings and psychiatric diagnoses, admitted children who were (*a*) sufficiently ill to prevent integration into a normal nursery school or kindergarten, but not so ill as to require institutionalization, and (*b*) not suffering from an organic mental or a physical impairment.

2. *Judging Procedures*

Eight female undergraduate-psychology majors and two male psychology professors served as judges. Neither the students nor the psychologists had had any previous experience or training in the psychological analysis or diagnosis of children's art.

For several weeks, teachers at the schools collected the children's easel paintings. By a random method, the authors selected for study four paintings for each child. The judges' task was to rate the 22 sets of paintings (four for each child).

The judging procedure was divided into two parts. The first task was to determine which sets of paintings were created by "normal" children and which by "disturbed" children. Paintings were judged separately by age group. Six of the subjects were 3 years of age; eight, 4; and eight, 5. Each age group was equally divided between "normal" and "disturbed" children.

The instructions to the judges were as follows:

> The purpose of this study is to see whether it is possible to tell from his paintings if a child is normal or emotionally disturbed. You will be given sets of paintings of 22 children. The sets of four paintings each are divided into three different age groups. Half of the children in each age group are normal; they are pupils in regular nursery schools or kindergartens. The other half are emotionally disturbed; they are in a special nursery school and kindergarten for emotionally disturbed children. Your task is to put all the paintings of children you think are disturbed in one pile and the paintings of children you think are normal in a second pile.

The second task of the judges was to indicate which of each of 11 brief personality descriptions of the "disturbed" children corresponded with each one of the 11 sets of paintings. The personality descriptions to which judges could refer during the matching task had been compiled by one of the authors from the descriptive phrases in the school's clinical reports. Four example descriptions are as follows:

Larry. This child is very active, so much so that he is on tranquilizers. He is unproductive, has temper tantrums frequently; throws himself on the floor, screams, and becomes rigid. He enjoys listening to records. Has poor span of attention. Does not play well with other children; he usually ends up fighting.

Mary. Has excessive fears. Used to have a terror of fire engines; she once saw her cousin burned. She is nonaggressive, hesitant, insecure, shy. As soon as play competition gets rough, she will leave. Afraid of negative answers from teachers. She has a good imagination.

Johnny. This child is quiet, overprotected. He sometimes relates to adults rather than children. He talks on and on about nothing. He wanders around. Likes to wash. Has very poor coordination. He will cover his head when he hears loud noises or another child cry. He may be autistic or schizoid.

Mark. He is overaggressive, difficult to handle at home and in school. Fights with younger brother. Looks for affection and attention all the time. He is very tall, but thin for his age. He had every childhood disease. He is a very unhappy child. He is unable to play peacefully with other children for more than a few minutes at a time.

C. RESULTS AND DISCUSSION

The results are given in Tables 1 and 2. Except for Judge 5, who made only five correct matches out of 22, every judge matched correctly 50 per cent or more of the paintings and personality descriptions. Judge 5 said after the first task that she thought there was a trick in the experiment and had merely guessed. Her results suggest that she tried to make her choices come

TABLE 1
RESULTS FOR INDIVIDUAL JUDGES

	Judgment that painting was created by a normal or a disturbed child			Judgment that personality description matched painting		
Judge	Right	Wrong	Per cent right	Right	Wrong	Per cent right
1	19	3	86	4	7	36
2	11	11	50	4	7	36
3	16	6	73	7	4	64
4	21	1	95	11	0	100
5	5	17	23	9	2	82
6	15	7	68	6	5	55
7	13	9	59	7	4	64
8	21	1	95	11	0	100
9	11	11	50	8	3	73
10	12	10	55	11	0	100
Total	144	76	65*	78	32	71

* Per cent right is 70 when results for Judge 5 are excluded.

TABLE 2
JUDGMENT THAT PAINTING WAS CREATED BY A NORMAL CHILD OR A DISTURBED CHILD

Age	*N*	Right	Wrong	Per cent right
3	6	41	19	68.4
4	8	48	32	60.0
5	8	55	25	68.8

out incorrectly. On the personality matching task, Judge 5 said that she had really tried.

To test the null hypothesis that there is no discriminable difference between the paintings of normal children and the paintings of emotionally disturbed children, we employed the matching-task formula recommended by Mosteller and Bush (9, p. 309). For 3-year-olds, z is 9.5; for 4-year-olds, 4.9; and for 5-year-olds, 9.8. The null hypothesis, therefore, can be rejected.

To test the second null hypothesis (namely, that one cannot match a child's paintings to a description of his personality), we used the matching-task formula recommended by Feller (5, p. 98). We found z to be 14.0, enabling us to reject the null hypothesis.

Something more than guesswork must account for the findings, but neither the judges nor the authors have been able to determine precisely why such high levels of accuracy were attained. Does there exist an "intuitive" capacity in the sense of immediate knowing without the conscious use of reasoning? If so, our results seem congruent with Baruch and Miller's position:

> . . . when we fail to bring our own understandings and associations to meet with what the child brings, we fail to comprehend what he reveals in his graphic language just as we fail to understand his verbal language when he speaks in a foreign tongue to which we are unable to bring meanings (3, p. 186).

D. SUMMARY AND CONCLUSION

The view that a child projects his personality through his painting has been widely accepted, despite the lack of convincing experimental evidence. In the present study, 10 judges examined the paintings of 22 boys and girls between the ages of 3 and 5, 11 of whom were enrolled in nursery schools and kindergartens for normal children and 11 of whom attended a school for emotionally disturbed children, and attempted to identify the paintings created by the disturbed children and those created by the normal children. In addition, the judges attempted to match the 11 paintings by the disturbed children with brief personality descriptions. All but one judge exceeded chance expectancy in a positive direction. The authors suggest that some kind of unidentified intuitive process explains the result.

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THE RELATIONSHIP OF NURSERY SCHOOL CHILDREN'S SOCIAL PERCEPTION TO SEX, RACE, SOCIAL STATUS, AND AGE*[1]

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A. INTRODUCTION

There is little question that people "see" different things in a social situation; the city is many things to many people. This is what perception means—an interpretation of a situation in terms of which the individual responds. As one reacts, feedback confirms the interpretation or suggests modifications. If feedback confirms the first interpretation, the observer's perception of and approach to the situation is sustained. When the first interpretation fails to be confirmed, the observer is stimulated to revise his perceptions and change his behavior.

Reactions to a city scene to be described later illustrate three propositions about the nature of perception. One is that the perceiver is *selective* in what he observes; i.e., he does not observe everything. Second, the perceiver brings to a situation a store of *meanings* or concepts that form the basis for his interpretation or adjustment. Third, perception often involves *affective* states or emotions. Less apparent is the part played by the perceiver's sensory equipment, his language development or ability to communicate (3) and his personality syndrome or characteristic modes of response.

The relationship between what a person perceives and how he acts implies that learning is not simply a matter of changing behavior, but depends upon change in perception. This being true, teaching involves the creation of new areas of awareness or a sensitivity to elements not previously "seen" nor in existence, so far as the learner is concerned.

B. PROBLEMS

Estvan and Estvan have demonstrated the growth taking place in children's social perception during the elementary school years and the relationship of social

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[1] This series of studies was made possible through support from College of Education research funds; the cooperation of Dr. Norma R. Law, director of the Nursery School, and her teaching staff (Mrs. Hui C. Wu and Mrs. Jean M. Green); and Elizabeth Estvan, who conducted all the interviews.

perception to rural-urban differentials, sex, and intelligence (4, 5). The present research deals with children younger than those studied earlier and focuses on two questions: First, "Is social perception related to variables such as sex, race, and social status among 3-year-old and 4-year-old children?" Second, "Does social perception develop rapidly during the nursery-school years or is that period a period of relative stability?"

C. SAMPLE

The sample included children attending the nursery school sponsored jointly by the College of Education of Wayne State University and the Detroit Housing Commission. Approximately half the children lived in the housing project in which the school is located; the remainder were selected from various parts of the metropolitan area to balance the representation of racial and socioeconomic groups. All told, during a two-year period, 78 children participated in 129 interviews.

D. METHODOLOGY

Data were collected through an individual, projective-type interview based on a series of 14 life-situation pictures created to reflect three social-background patterns: (*a*) a community block including rural-life and urban-life situations, (*b*) a social-status block contrasting upper-class and lower-class situations, and (*c*) a child-adult block presenting situations commonly associated with child-adult or age differentials. The series covered the basic social functions, such as conservation of human and natural resources; the production, distribution, and consumption of goods and services; transportation; and government. The interview consisted of three phases designed to cause a gradual increase in personal involvement. First, two-inch by two-inch black-and-white slides were projected on a 30″ × 40″ screen and the child was asked, "What story does this picture tell?" Second, the pictures were re-presented as 11″ × 8½″ photographs, and the child was asked to select from among eight cardboard figures of happy, sad, angry, or neutral boys and girls the one cardboard figure that "belongs in the picture" and to indicate why he made his selection. Third, the child was asked to choose the two pictures he liked best and the two he liked least and (in each case) to tell why (2).

E. DATA

All responses were tape recorded and were typewritten verbatim. The following reactions to *The City*, a street-corner scene, illustrate the nature and range of the responses and certain of the scoring categories:

1. *Part I: What story does this picture tell?*

It tells when dey going downtown an dey an dey gonna . . . goin' on da bus (Recognition—structure).

Wait for busses wait for cars whoever picks you up and they go in the store an buy shopping an they put the clothes on (Recognition—function).

Once there was a some people on the street in the morning but all the cars were zooming zooming zoom zoom zoom to the work the children were going to school an the busses were rushing an an an an all the people were walking on the street (Recognition—partial description).

It tells dat everybody's waiting at da corner an da car's going by an ah some people are going into da store (Recognition—partial description).

Dat's a supermarket an groceries an gas station an maybe hospitals (Recognition—identification).

They all started back for for the the the curb cause a car is coming . . . an a bus right there by buildings like that (Recognition—general description).

Bus an car an church an a lady an a man an a boy an girls (Recognition—miscellaneous listing).

'Bout da church an an church an dere's too much cars an busses won't be able to get in da church before da church came out the father came out an dey are comin' again coming agin in da church (Recognition—inappropriate).

Da bus is running down da street an da cars is cars an de light get red an blue an get yellow an white an green . . . when it everyday when it gets dark everynight da week everyday make it all dark in here (Recognition—indefinite).

Um I can't tell (Recognition—no response).

2. *Part II: Which boy or girl belongs in this picture? Why?*

Happy girl. Cause I see a happy girl in dere . . . cause she wants to go in stores an buy something (Attitude—positive).

The happy boy. So he could walk around an so he could go to the store an go back home and he could put on his coat (Attitude—positive).

Da sad little boy. Cause he don't like to go downtown (Attitude—negative).

Uh well dis boy . . . it da happy boy. Because he likes to ah because he want to ah he wants to cross da street with his mommy so he started to smile (Attitude—positive).

Happy boy. Uh cause dere's some happy boys an papers (Attitude—positive).

This one . . . da sad da da hap da da happy one. Because he didn't forget anything (Attitude—mixed).

(Points to mad boy). Cause he went walking down da street an da people who didn't wanta . . . yeh he didn't wanta see da happy man cause he didn't like him (Attitude—negative).

Happy boy. Cause he's a boy but he's gonna get wunned over when cars stopped when the busses an the cars stopped he hurried up across the street but da green light came an den he wunned over . . . he couldn't cause he had to stop at the green light . . . and den the cars went and den da boy got wunned over (Attitude—mixed).

(Points to the happy girl). Because I can't tell you why because I can't even tell my moder (Attitude—positive; Reason—indefinite).

(Points to happy girl). Because (Attitude—positive; Reason—no response).

3. *Part III A: Which picture do you like best? Why? (Attitude—positive)*

Cause its downtown (Reason—neutral).

Because that's my favorite that's my favorite because because I jus like cars (Reason—positive).

Cause it has a bus (Reason—neutral).

Dat car and dat house (Reason—neutral).

Cause that's my favorite friend (Reason—positive).

Because I want to take it home too (Reason—positive).

Cause I like it (Reason—positive).

It's an easy one (Reason—neutral).

Dat's why (Reason—indefinite).

I wanted the train (Reason—indefinite).

4. *Part III B: Which picture don't you like? Why? (Attitude—negative)*

Cause they ride busses and cars (Reason—negative).

I just don't I don't like a group like dat either (Reason—negative).

I don't like the train one (Reason—indefinite).

Cause cause the policeman does want to get each other (Reason—indefinite).

I don't know (Reason—no response).

Two persons scored the protocols independently, and differences were discussed until consensus was reached. Score dimensions were as follows:

1. Recognition—appropriateness, level (whole, part).
2. Spatial setting—home, community, state, nation, etc.
3. Temporal setting—past, present, future, etc.
4. Attitude—positive, negative, neutral, mixed.
5. Picture preference—liked, disliked.
6. Figure selection—life space for boys, for girls.

F. RELATIONSHIP OF SOCIAL PERCEPTION TO SEX, RACE, AND SOCIAL STATUS

The most obvious factors conditioning experience are sex, race, and socioeconomic status. Sex roles may not be as sharply defined as once was the case, but the life spaces for boys and girls are not contiguous. Certain patterns of living characterizing ethnic and racial groups may be detected, and so can contrasts in experience associated with extremes in social status.

1. *Sex Groups*

Twenty boys and 19 girls (with mean ages of 47.0 months and 48.3 months) were found to be much alike in *recognition*. This is true with respect to the distribution of responses as well as with respect to the proportion of appropriate reactions. Girls, however, did excel in synthesis scores (the highest level of perception involving an awareness of both structure and function); whereas boys had a larger proportion of partial description responses (especially with reference to the natural environment). For no single picture in the series, however, was there a statistically significant difference between the responses of boys and girls.

In terms of *spatial setting,* boys and girls were alike in the proportion of systematic referents (e.g., "in Detroit"), associational referents (e.g., "in the store"), and indefinite levels of referents. There were some differences among specific categories. Girls used more community referents; boys gave more unspecified reactions.

There was a sex difference in levels of *temporal setting*. Girls used more associational responses ("in the morning"); boys, more indefinite responses.

In *attitude* toward the picture series as a whole, girls were more positively oriented; boys, more neutral. This difference was most evident in Part II of the interview. Girls selected more happy-looking figures that "belong in this picture." To support their selections, girls were more positive; boys, more noncommital or neutral.

Picture selection revealed agreement on two of the four scenes most highly regarded by boys and girls: the Rich House and Schoolroom. Boys preferred the Farm and City; girls preferred the Bedroom and Poor House. No such agreement was evident in the scenes rejected. Boys disliked the Bedroom, Dam, and Church. Girls disliked the Poor House, Old Beach, the City, and Schoolroom.

On *figure selection,* boys and girls are similar in their awareness of life space. Scenes associated with one sex or the other accounted for 71.5 per cent of the boys' responses and 71.7 per cent of the girls'. Except for the Rich House, in which case each group entered a significantly greater number of figures of their own sex, life space does not appear to reflect sex identification.

The difference in the distribution of life-space designations for the series as a whole is due to the greater number of indefinite responses on the part of girls.

2. *Racial Groups*

The Negro group outnumbered the Caucasian (23 *vs.* 16) and was 4.6 months older, the mean chronological ages being 50.0 and 45.4 months respectively. Statistically, the difference is not significant but, developmentally, it may have considerable significance; therefore it is noted in our interpretation of the findings.

The total number of responses credited with *recognition* is essentially the same for the two racial groups. For several of the categories and the two life situations, however, variations appear. Negro children are more aware of structure—especially of the type classified as immediate, limited to the scene, and not extended further or generalized. In nonrecognition responses, Caucasian children are more aware of cultural clues in general descriptions of life situations and also have more no-response scores. More Negro children recognize the Church; more Caucasian children show an awareness of the Farm.

For both *spatial setting* and *temporal setting,* racial groups differ in the proportion of responses classified at the various levels. Negro children use more systematic space referents; Caucasian children use a greater number of indefinite responses. Caucasian children are higher in no-response scores; Negro children yield a greater number of institutional scores. A similar pattern is evidenced on time: Negro children use more associational clues; Caucasian children, more indefinite responses.

A difference in the *attitudes* of the two groups was manifested at the very outset of the interview. In Picture Stories, Negro children are more neutral. Caucasian children react strongly either in a positive or negative fashion and are more indefinite. In Part II of the interview, the noncommittal approach of the Negro group changed to a significantly higher proportion of happy responses in the case of *figure selection* as well as to more positive and negative scores for *figure reason*. The greater proportion of indefinite reactions on the part of Caucasian children manifests itself again in connection with *figure reason*. Except for Caucasian children, who were younger and perhaps less able to deal with the task, Negro children were slower in becoming involved in the interview process.

The Rich House and Schoolroom are among the preferred pictures of both Caucasian and Negro children. Negro children also hold the Bedroom in high regard. Farm and City were favored by the Caucasians. More Negro children expressed an aversion for the Poor House; more Caucasian children rejected the Old Beach.

In *figure selection*, the proportion of situations identified with either boys' life space or that of girls is approximately the same for Caucasian and the Negro children (68.5 per cent and 73.9 per cent). Negro children, however, are much more likely to designate *girls* as "belonging in this picture." This proclivity for feminine identification is not unduly weighted by one or a few life situations, but is exhibited generally throughout the series.

3. *Status Groups*

The Warner Index of Social Characteristics (based on occupation, source of income, type of house, and residential area) was used to determine social status (6). The 22 higher-status children represent professional and managerial families; the 20 lower-status children represent semiskilled and unskilled parents.

The foregoing groups are close to each other in mean age and do not differ markedly on the proportion of boys and girls, but Negro children are more highly represented in the lower-status group than in the higher-status group.

The *recognition* of high-status groups and low-status groups is similar in the proportion of appropriate responses and their distribution among the various scoring categories. Differences are limited to two items and to one life situation. Higher-status children produce relatively more human responses; lower-status children give more miscellaneous listings. On the Resort scene, the higher-status children excel in the total number of appropriate responses.

Awareness of *spatial setting* and *temporal setting* is similar for the two groups. No differences are revealed on any level or category. This degree of similarity is not equalled in any other group comparison.

There are marked variations in *attitude* between the status groups. Children from low socioeconomic background are significantly more neutral; high-status children are more negative and varied and indicate vacillation between positive and negative expressions. There appear no systematic differences in the approach taken to the interview, but lower-status children give more indefinite responses in *figure selection*.

For both groups, *picture selections* include the Rich House and the Farm. High-status children are attracted to the Bedroom and School; lower-status children add the Poor House and City. In each group, one of the best-liked scenes is also the most rejected. For lower-status children it is the City; for the higher-status children, it is the Bedroom, tied with the Dam, that is the least-preferred life situation.

In *figure selection,* each status group identifies approximately the same proportion of situations as fitting life space for a boy or a girl (65.1 per cent, low-status children; 68.6 per cent high-status children). The groups differ, however, with respect to each of the figure categories. Children from low socioeconomic backgrounds introduce more *girls* into the picture series, whereas children with high socioeconomic backgrounds place more *boys* into the scenes. In addition, the former are less certain (indefinite) as to which figure is more appropriate, but the latter regard more situations as suitable for both boys *and* girls. This variation in awareness of life space is the greatest among the various group comparisons made (1).

4. *Summary*

A summary of statistically significant differences in social perception by sex, race, and social status is presented in Table 1. Each variable is associated with differences in all three components of social perception: cognitive, attitudinal, and preferential.

G. RELATIONSHIP OF SOCIAL PERCEPTION TO CHRONOLOGICAL AGE

This phase of the study is concerned with development in social perception taking place during the nursery-school years. Both cross-sectional and longitudinal approaches are employed. The former involves 14 3-year-old children and 25 4-year-old children (mean ages = 41.2 months and 53.1 months respectively). In each age classification, the representation of sex and race is not significantly discrepant. The longitudinal study is based on 16 children. Their mean age was 44.3 months the first year and 55.3 months the following. Differences in sex and race are not statistically significant.

1. *Cross-Sectional Study*

Four-year-olds reveal a striking superiority in the total number of appropriate *recognitions* of the picture series (30.3 per cent *vs.* 45.5 per cent). This is evident on many categories of the recognition scale including the highest level, *synthesis,* and *partial descriptions* in contrast with the lower level of *identification* scores by three-year-olds. Even among nonrecognition responses, older children register a higher level (general description) than younger children more of whom engage in *miscellaneous listing* or provide

TABLE 1
NATURE OF SIGNIFICANT DIFFERENCES IN GROUP COMPARISONS

Perceptual component	Sex		Race		Social status	
	Boys	Girls	Caucasian	Negro	Low	High
Recognition						
Level	Partial Description	Synthesis	General description, No response	Structure	Miscellaneous listing	
Type	Natural (Partial)		Cultural (General)	Immediate (Structure)		Human (Partial)
Life situation			Farm	Church		Resort
Spatial setting						
Level			Indefinite	Systematic		
Type	Unspecified	Community	No response	Institutional		
Temporal setting						
Level	Indefinite	Associational	Indefinite	Associational		
Type						
Attitudes						
Part I			Postive, Negative, Indefinite	Neutral		
Part II	Neutral reason	Happy figure, Positive reason	Indefinite reason	Happy figure, Positive and Negative reasons	Indefinite figure	
Part III						
Summary	Neutral	Positive	Negative		Neutral	Negative, mixed
Picture preference						
Prefer	Farm, City	Bedroom, Poor House	Farm, City	Bedroom	Poor House, City	Bedroom, School
Dislike	Bedroom, Dam, Church	Poor House, Old Beach	Old Beach	Poor House	City	Bedroom, Dam
Figure selection						
Figure		Indefinite		Girls	Girls, Indefinite	Boys, Boys and Girls

no response of any kind. These differences are most noticeable on the Rich House and Schoolroom scenes.

Older children also surpass the younger in awareness of *spatial setting*. With reference to levels, they use more *systematic* and *associational* referents; whereas younger children produce a greater number of *indefinite* reactions. As for specific categories, the four-year-old is more likely to associate situations with *nature* and *institutions;* whereas the predominant category for younger children is the *unspecified*.

There is little difference between the groups in sensitivity to the *temporal setting* of life situations. The difference is confined to the greater proportion of *unspecified* as compared to *no-response* scores of the older and younger group respectively.

Marked differences in *attitude* are noted in four of the five scores summarizing children's affective responses toward the picture series. The trend with age is from *indefiniteness* and *neutrality* toward *negativism* and *mixed* feelings. The first is evidenced by three-year-olds from the outset (*picture story*) and continues throughout the second phase of the interview (*figure selection* and *figure reason*). No such pattern appears on the part of 4-year-olds, but their *figure selections* are more neutral in tone compared with the vague or *indefinite* responses of the younger group.

In their *picture preferences,* both groups include the Farm and Rich House. Even greater preference is expressed for the Schoolroom by the younger children; the 4-year-olds add the Bedroom and City to their list. There is no agreement on dislikes. For the 3-year group, the Schoolroom heads their rejections; the Bedroom is among the older children's dislikes in company with the Poor House and Church.

The three-year and four-year groups are remarkably alike in *figure selections*. Their distribution among the various sex choices as well as the total number of times that a boy or a girl is designated (75.3 per cent *vs.* 72.9 per cent) are similar. The only difference in awareness of life space that is associated with age is the shift from a preponderance of girls to that of boys for the Farm situation.

2. *Longitudinal Study*

In one year, *recognition* increases significantly in terms of the proportion of appropriate responses (34.6 per cent to 52.0 per cent) as well as in the distribution of scores among the 16 categories. The greater number of *structural* responses classified as *immediate* change to *functional* reactions of an *extended* nature. This shift represents greater perception both as to level and type. The second year also produces more *partial descriptions* centering on the *human* element. Development is also apparent among the nonrecognition categories. Whereas the first year is marked by a greater number of *miscellaneous listing, inappropriate,* and *no-response* scores, the second produces a greater proportion of *general description* responses (the highest category in nonrecognition level). The second year also sees marked improvement in recognition of the Old Beach scene.

There is some evidence of increasing awareness of *spatial setting* from one year to the next in the distribution of scores among the eight categories. Specifically, there is greater orientation to the *home* the first year whereas the second is accompanied by a greater consciousness of *nature* as the setting for life situations. At the same time, the *no-response* scores of the earlier interview are now scattered among higher categories on the *indefinite* scale. No development in awareness of *temporal setting* is discernible between the two interviews.

Attitudes show great changes during this period. At three years of age, children are generally *indefinite* in their feelings toward the life-situation series. The following year, they tend to be more *positive*. The indefiniteness of the three-year-old is most apparent in the *figure-selection* and *figure-reason* phases of the interview. Coupled with this, is a greater show of *negativism* in his *figure reasons*. In one year, vagueness or lack of response in *figure selection* and *figure reason* is replaced by reactions that are clearly neutral in character.

There is close agreement from year to year in the *picture preferences* of this group of children. For the Farm, School, and Bedroom the number of choices and rank are almost identical. On dislikes, however, there is no agreement. First, the Dam and School are most rejected. One year afterward, the Factory and Rich House are singled out.

As indicated in their *figure selections,* a heightened sense of life space develops between 3 and 4 years of age (from 62.3 per cent to 83.5 per cent). The distribution among the various sexes and combinations differ primarily because, with age, more *boys* are identified with life situations. This is especially true of the Factory and City scenes.

3. *Summary*

There is no one-to-one correspondence in the findings of the cross-sectional and longitudinal studies. This may be attributed to sampling fluctuations as well as to the kinds of control possible in these two approaches. For example, the effects of one year of previous nursery-school experience are obviously limited to the longitudinal group. Nevertheless, there are certain points of agreement that provide the broad outlines for describing development in social perception taking place between the ages of three and four. Having been tested as statistically significant in *both* the cross-sectional and longitudinal analyses, considerable confidence may be held in the conclusions to be reported next.

H. Conclusions

The evidence indicates that nursery-school children's social perception is related to sex, race, and social status. Differences are evident in each group comparison. They appear in each component of social perception, the greatest number falling in the realm of values and attitudes; the fewest, in awareness of a space-time setting or field. Specifically:

1. *Boys and girls differ in their social perceptions*. Girls are more perceptive in cognitive aspects and display more positive attitudes toward life situations. Boys are definitely more neutral. Although boys and girls share a common interest in the home and school, the pattern of preferred life situations is more consistent for girls. As further evidence of earlier acculturation, girls display some awareness of social status by their rejection of the two low socioeconomic life situations included in the series.

2. *Caucasian and Negro children differ in their social perceptions*. In keeping with their greater age, Negro children show more awareness in cognitive aspects of perception than the Caucasian. Differences in mode of response are striking. Negro children begin in a noncommittal fashion and take longer in becoming involved to the point of expressing feelings. Caucasian children react more definitely from the very beginning of the interview and account for more negative expressions toward the series as a whole. Both groups share a preference for a nice home and the school and reject low socioeconomic living, although the situations are different. The Negro child's greater recognition of the church and identification of girls with life situations may reflect the place of religion and matriarchal family patterns in Negro subculture.

3. *Lower-status and higher-status children differ in their social perceptions.* There is a slight relationship between social status and the cognitive aspects of social perception in that higher-status children are superior in *recognition*. That the subculture may be more operative on higher-status children than the lower may be inferred from the former's greater awareness of the Resort scene and the selection of the Schoolroom among their preferred life situations. Coupled with this is an earlier crystallization of attitudes expressed as

negative or mixed feelings. In contrast, children from lower socioeconomic backgrounds do not appear to be as much aware of or concerned about lower-status living. (The Poor House is one of their preferred pictures.) In keeping with this lack of awareness is their greater proportion of neutral reactions. Earlier acculturation, however, does not explain why the higher-status group is more boy conscious and the lower group more girl oriented. This difference in awareness of life space may reflect class differentials regarding the presence and role of male adults in the family.

The generalization is also warranted that the *nursery school period is one of rapid development in social perception.* Except for orientation to time, the profiles for all components show significant changes between 3 and 4 years of age. Greatest gains take place in the recognition of life situations, and the development of feelings about them. As children grow older, both constancy and change are evident in their valuing of life situations and there is greater awareness of boys' life space. Specifically:

1. *Development in social perception is differential.* All components do not move uniformly on a broad front; neither does awareness increase globally with respect to all types of life situations.

2. *Development is greatest with respect to recognition.* There are six points of agreement between the two studies every one of which reflects gains taking place between 3 and 4 years of age. In both the cross-sectional and longitudinal analyses, significant differences appear in the total amount of recognition and distribution of responses among the 16 categories, in the greater frequency of *partial description* and *general description* scores of the 4-year-olds, and in the larger number of *miscellaneous listing* and *no-response* scores of the younger children. Although there is no consistency in the life situations showing greatest gains with age, the influence of experience (Schoolroom) and the learning of cultural norms (Rich House, Old Beach) are suggested by the findings.

3. *Some development takes place in the awareness of spatial setting.* Of the three findings common to both studies, the most significant is the increasing awareness of the 4-year-old to *nature* as the setting for many life situations. The significant difference in the distribution of scores is largely due to the greater proportion of *no-response* scores of the 3-year-olds. No appreciable gains take place, however, in using geopolitical referents for designating space.

4. *There is no appreciable development in the perception of temporal setting.* This is confirmed in each study (no significant difference in the distribution of scores) and is the only component of perception showing no change with age.

5. *Attitudes change markedly between 3 and 4 years of age.* Both studies reveal marked differences in the attitudes of 3-year-old and 4-year-old children. The most consistent trend in the five agreements is *away from* the *indefinite* reactions of the 3-year-old highlighted in *figure selection, figure reason,* and overall (summary) estimate of emotional tone. Changes *toward* definite feeling tones appearing in the two studies are in opposite directions (*positive, negative*) indicating both flexibility and susceptibility to learning or conditioning.

6. *There is constancy and change in the valuing of certain life situations.* Great interest in the Farm is manifested at each age level. Except for the younger group in the cross-sectional study, the Bedroom is also high in preference. The importance placed on the School by 3-year-old children in both studies is also evidenced by the 4-year-olds in the longitudinal analysis. Contrariwise, the extreme dislike for School voiced by a considerable number of the younger children in each study is not evidenced in either of the 4-year groups.

7. *There is a growing awareness of life space for boys.* In both studies, 4-year-old children associate more boys with certain life situations than did the younger group. In the cross-sectional analysis this is especially noticeable with respect to the Farm. The longitudinal group displays this same tendency on the Factory and City scenes.

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PERSEVERATION LEARNING SET FORMATION TO NONREWARDED CUES BY NORMAL AND PREVIOUSLY IRRADIATED RHESUS MONKEYS*

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A. Problem

Excitation has been demonstrated to be the prepotent mechanism of response-perseveration learning set for nonrewarded cues (1, 2). Normal male and female rhesus monkeys do not differ significantly from each other, and irradiated female monkeys do not differ significantly from normal female monkeys.

The purpose of the present study is to determine if previously irradiated male monkeys differ from normal male monkeys with respect to the acquisition of the same learning set: i.e., with respect to the acquisition of two-trial response-perseveration learning set for nonrewarded cues.

B. Materials and Methods

1. *Subjects*

Nine rhesus monkeys, ranging in age from approximately 7 to 9 years, served as *S*s. Five years before the present study, four of the *S*s had been exposed to chronic fast-neutron radiation: 24-hour whole-body exposure every four days at 87.2 mrep per hour until a total dose 583 rep was achieved. The five control *S*s had been sham exposed during the same period.

The training histories of the *S*s were virtually identical and did not include any previous formal training on any learning-set paradigm.

2. *Apparatus*

Testing was done in a modified version of the Wisconsin General Test Apparatus. A stimulus tray holding two food wells, placed 12 inches apart (center to center) was used. The stimuli for testing were 336 test objects

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differing in multiple dimensions: i.e., in size, shape, and color. Every seven days, the pairings and order of presentation were rerandomized.

3. *Procedure*

Each day for 16 days each *S* was tested on 24 two-trial object-quality discrimination problems. On the initial trial for each problem *S* found *no* food, regardless of his choice of stimulus objects. On the second trial for each problem, *S* was given food if he displaced the object displayed on the initial trial. On the second trials of successive problems, the reinforced objects were aperiodically but evenly varied between right and left positions.

C. Results

Figure 1 shows the percentage of errors for the *S*s of the two groups during successive four-day periods of practice. Analysis of variance yields a difference between groups significant beyond the .05 level and a practice effect

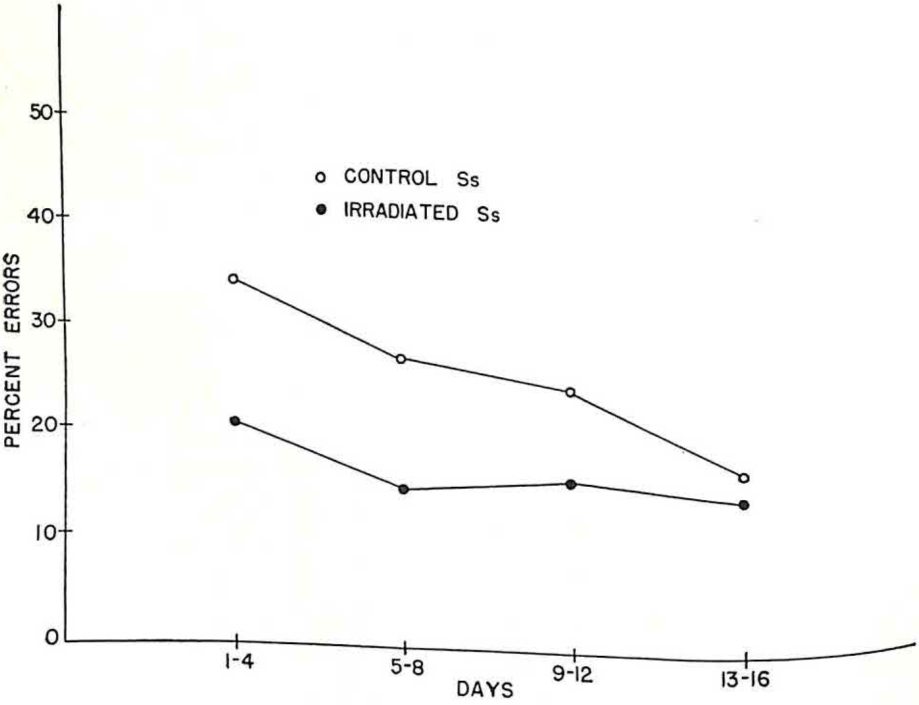

FIGURE 1
The Per Cent of Errors for Each of the Two Groups During Successive Four-Day Periods of Practice

significant beyond the .001 level. The *S*s of the irradiated group are superior to those of the control group.

D. Discussion

Our findings show irradiated male monkeys to be more capable than normal monkeys in the utilization of the excitatory properties of nonrewarded cues and reflect possibly the narrowed scope of attention that Overall and Brown (3) have reported for irradiated male monkeys. In Overall and Brown's study, high-dose irradiated *S*s, more frequently than normal *S*s and low-dose *S*s, showed discrete trial associations with the discriminable *stimulus* reinforced but not with the *position* reinforced.

E. Summary

Five control and four whole-body irradiated male monkeys served as *S*s. The irradiated *S*s had been given chronic exposure to fast-neutron radiation more than five years earlier. Each *S* was tested 24 trials per day for 16 days on two-trial response-perseveration learning set for nonrewarded cues. The results show significant improvement with practice and significant superiority of the irradiated *S*s over the control *S*s.

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PRE-EXPERIMENTALLY ACQUIRED VERBAL RESPONSES DURING ACQUISITION AND SUBSEQUENT USE OF EXPERIMENTALLY ACQUIRED VERBAL RESPONSES IN CONCEPTUAL BLOCK SORTING*[1]

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A. INTRODUCTION

The present experiment continues a series of experiments (4, 5, 6, 8) on the role of verbal mediating responses in conceptual block sorting. The stimuli of the last three of the four experiments just cited were 16 blocks that were combinations of tall or short, large or small and square or circular top and bottom areas, and black or white. The verbal responses that were to be acquired or strengthened were assigned to the blocks in terms of height and size. For example, one verbal response was assigned to the four blocks that were tall and large; and each of three other verbal responses were assigned to the subsets of four blocks that were (*a*) tall and small, (*b*) short and large, and (*c*) short and small. In two experiments (5, 6), the verbal responses were a set of four trigram nonsense syllables of consonant-vowel-consonant (CVC) structure and a set of four pairs of familiar words that were names for the values of the height-size categories. In the third experiment (8), only the CVCs were used.

Following the attainment of one or more degrees of mastery of the CVC or familiar-word responses, all *S*s were given four trials of conceptual block sorting. On each trial, *E* placed a different block from each of the different subsets of four blocks of each height-size category at one of the corners of a square sorting board. *E* then presented successively each of the remaining 12 blocks, so that *S* could place each of them with the block it matched. Placements were scored as correct by height and size when a block in a particular height-size category was placed in the corner occupied by the block of that category.

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Acquisition of verbal responses by height and size increased the numbers of placements by height and size over the numbers of placements obtained for control conditions (4, 5, 6, 8). The control conditions were (*a*) no prior exposure to the blocks or (*b*) prior exposure to the blocks with instructions to look at and discriminate among them. The greater the mastery of the verbal responses, the larger the numbers of placements by height and size relative to those for the control conditions (6, 8). These findings were viewed as consistent with implications of an interpretation of conceptual block sorting as mediated by the verbal responses that had been acquired or strengthened in the task of the preceding session. This interpretation assumes occurrences of the experimentally acquired common verbal responses for each height-size category to from two to all blocks of the particular category. Further, the interpretation implies that the common verbal response increases similarity among the blocks in each particular category and decreases the similarity between the blocks of a particular category and the blocks in other categories. The response-mediated similarity of blocks within a category and the response-mediated dissimilarity of blocks among categories is assumed to be the basis of the increased number of placements by height and size.

The verbal responses that increase intracategory similarity and decrease intercategory similarity are presumed to be the CVC or familiar-word responses that, in the experimental context, had been strengthened to one or more degrees of mastery. In the case of the CVC responses in particular, however, there remains the possibility that acquisition of those responses served merely to activate and to strengthen differentially height-size "responses" that had been acquired pre-experimentally. The basis, therefore, of the presumed verbal mediation of sorting by height and size might have been the pre-experimentally acquired responses rather than the experimentally acquired responses.

An alternative interpretation that experimentally acquired CVC responses influences conceptual block sorting by height and size indirectly through the activation and differential strengthening of pre-experimentally acquired verbal responses entails three problems. The first problem is whether or not the postulated changes in pre-experimentally acquired responses by height and size occur during the acquisition of the new CVC responses. The second problem is whether CVC responses by height and size or pre-experimentally acquired responses by height and size or both occur during block sorting. The third problem is whether or not occurrences of CVC responses or pre-experimentally acquired responses by height and size are related to placements by height and size.

The purpose of the present experiment is to obtain information pertinent to the foregoing problems. The first objective is to assess initial occurrences of and any subsequent changes in occurrences of pre-experimentally acquired verbal responses during the acquisition of the assigned CVC responses. The second objective is to assess the occurrences of pre-experimentally acquired and experimentally acquired verbal responses during conceptual block sorting. The third objective is to ascertain the relationship between verbal responses by height and size and placements by height and size. All three objectives are to be implemented by manipulating two variables each of which is expected to influence the occurrences of pre-experimentally acquired verbal responses during the acquisition of the assigned CVC responses and the occurrences of the pre-experimentally acquired *and* the experimentally acquired responses during conceptual block sorting. One of the two variables is type of instruction for the activation of the pre-experimentally acquired verbal responses during acquisition of the new CVC responses. The second variable is the pattern of relationships between the blocks and the new CVC responses.

1. *Occurrences of Pre-experimentally Acquired Verbal Responses*

The assessment of the occurrences of pre-experimentally acquired verbal responses during the acquisition of new responses is important for several reasons. First, more complete information is obtained about *S*s' initial repertoires of responses. Second, facilitative or inhibitory effects of pre-experimentally acquired responses may be noted. Third, *S*s' repertoires of responses at the end of acquisition may be made known more completely, so that any subsequent changes in those repertoires and their consequences during retention and transfer can be understood in greater detail.

Of three general approaches to assessment of pre-experimentally acquired responses, the least direct is *S*s' postacquisition reports of the bases or principles used to guide responses during the acquisition of new responses. This approach gives little or no information on trial-by-trial changes. The principles may be verbalized correctly, but they may not have been used correctly or vice versa. Further, the principles may be verbalized in manners unfamiliar to or not understandable by *E*. Sometimes, *S*s have been required to verbalize the principles after the last trial with each set of stimuli (e.g., 3); but such reports are retrospective and usually are not specific to each stimulus.

A more direct approach involves instructions to *S*s to say overtly any "thoughts," "ideas," or "hypotheses" aroused by each stimulus (e.g., 7). But the verbalizations often are variable and extensive, within as well as between

*S*s; *S*s may not verbalize their "thoughts" completely; and the use and the form of the overt "thoughts" may differ from the use and the form of more "natural" covert "thoughts." However, by the approach, one obtains trial-by-trial information about pre-experimentally acquired responses.

Perhaps the most direct approach that can be used is the selection of overt "new" responses among the presumed repertoires of overt or covert pre-experimentally acquired responses (e.g., 4, 5, 6). In other words, changes in overt responses are observed directly, and a change in a covert response is inferred from a change in an overt response. Conceivably covert responses can be disregarded.

The three sets of instructions employed in this experiment and the three patterns of relationships among the block stimuli and the new CVC responses were designed to vary the extent of the activation and the differential strengthening of pre-experimentally acquired responses. The first set of instructions ("overt" instructions) calls for restricted overt verbalizations of pre-experimentally acquired responses prior to the overt anticipation or the overt recall of the new CVC responses. The purpose of the instructions is to provide trial-by-trial information about initial and later occurrences of pre-experimentally acquired responses. The responses are restricted to the names for the dimensions and the values along the dimensions represented in the block stimuli. Only two responses to each stimulus are permitted.

The second set of instructions ("covert" instructions) calls for the covert verbalization of the pre-experimentally acquired responses. These responses are restricted to the dimensions and the values along the dimensions represented, and only two responses are permitted. A test trial calling for overt verbalization is necessary to determine the terminal pattern of relationships between the pre-experimentally acquired responses and the experimentally acquired responses and between each of the foregoing and the stimuli.

The third set of instructions ("regular" instructions), previously used with adults (5, 6, 8), does not direct *S*s with respect to the occurrences of pre-experimentally acquired responses. A departure from previous practice, however, is the addition of a postcriterion trial for which *S*s are instructed to say overtly any pre-experimentally acquired responses used during the preceding acquisition trial.

The "overt," "covert," and "regular" instructions were combined orthogonally with three patterns of relationships among the block stimuli and the assigned responses. One pattern consisted of a fixed relationship between each block stimulus and the stimulus for the response to be associated with the block stimulus. This is the conventional arrangement of the same response member always accompanying the stimuli of a particular height-size category. By coming to respond to the blocks in each height-size category by pairs of pre-experimentally acquired verbal responses referring to their values for height and for size, *S*s could simplify the task considerably. Instead of 16 associations, one between each block and one of the four CVC responses, there would be only four associations, one between the stimuli produced by each pair of verbal responses by height and size and each of the CVC responses. Such activation and differential strengthening of pre-experimentally acquired responses by height and size is seemingly prerequisite to these responses replacing the CVC responses in subsequent block sorting as the mediators of placements by height and size.

A second pattern involved trial-to-trial changes in the relationships between each block stimulus and the response to be associated with each block. With this variable relationship, *S*s cannot (except by chance) respond perfectly on any trial. If *S* were able to make a different pre-experimentally acquired response to each stimulus representing a particular combination of values, he might be able to attain a relatively high level of correct responding.

The third pattern involved no new terminating verbal responses. The pattern is designated NTR. Under "overt" and "covert" instructions, *S*s saw the stimuli and made pre-experimentally acquired responses overtly or covertly. Under "regular" instructions, *S*s looked at each stimulus carefully. Any overt or covert verbalizations of pre-experimentally acquired responses that may have occurred were not due to *E*'s instructions.

2. *Pre-experimentally Acquired Responses and Experimentally Acquired Responses During Block Sorting*

Prior to block sorting, *S*s were instructed to name each block and to match it or place it with one of the four blocks on the board. Specific names were not requested nor were *S*s told what responses to use.

If one disregards fixed or variable pairings, predictions about the effects of instructions are contingent on at least two factors. One prediction relates to the effect of the direction and the degree of differences among instructions on the final differential occurrences of pre-experimentally acquired responses (in terms of height, size, or height *and* size). The other prediction relates to the effect of differences among instructions on the extent and patterns of transfer of pre-experimentally acquired and experimentally acquired responses.

No well-established and pertinent principles were available to permit *a priori* specification of the effects of either factor.

Predictions about the effects (if any) of fixed or variable patterns of relationships are contingent on the same two factors. Neither could be specified in advance. Therefore, during the acquisition of new verbal responses, the final differential occurrence of pre-experimentally acquired responses in terms of height, size, height and size, and other characteristics was determined. Differential occurrence of those responses during block sorting was also assessed.

B. METHOD

1. *Stimuli and Apparatus*

The stimuli for verbal pretraining and block sorting were 16 small blocks each of which was a given combination of (*a*) height—tall (one inch) or short (one-half inch); (*b*) size (or area) of the top and bottom—large (.80 square inch) or small (.45 square inch); (*c*) shape of top and bottom—square or circular; and (*d*) color—white or black. One block was tall, large, square, and white; another, tall, large, square, and black; and so on. CVCs BIK, CEV, LAG, and MUR were assigned to the tall large blocks, tall small blocks, short large blocks, and short small blocks respectively.

The apparatus for presenting the blocks was an exposure device with a two and seven-eighths inch by four and three-sixteenths inch window at the bottom of the front panel. The window was closed by a shutter, which was raised to expose the blocks. The raising of the shutter activated a microswitch that started a Cramer timer set for three seconds. At the end of three seconds, a light inside the box was activated and indicated to *E* that the anticipation interval had ended. *E* then told *S* the name of the block. Next, the shutter was closed and the block for the next trial was properly placed.

For block sorting, the same apparatus was used, along with a 12-inch square, wooden panel divided (by one-half inch black lines) into four equal squares into which the blocks were sorted.

2. *Procedure for the Acquisition of New Verbal Responses*

The instruction common to the "overt" and "covert" instructions was for *S* to respond first to each block by labeling, referring to, or specifying the first one or two characteristics (but no more than two characteristics) that occurred to him and then to anticipate or recall the CVC response for that block. The "overt" instructions required *S* to say the characteristics aloud; the "covert" instructions, to say them silently. The "regular" instructions, those used previously (5) but modified for alternate anticipation and recall trials, were silent on the point at issue.

The foregoing instruction conditions were combined with the three patterns of the relationships of the blocks to the criterion or terminating CVC responses. The fixed pattern involved the same CVC response for the blocks in each of the four height-size categories through successive trials. The variable pattern involved different CVC responses on successive trials. For example, on one trial a particular CVC was paired with the blocks in one height-size category; and each of the other CVCs was paired with the blocks in one of the three remaining height-size categories; and these assignments (subject to the constraints that the CVCs were always assigned in terms of height and size and that no pattern of assignment was repeated within successive blocks of four trials) varied randomly from trial to trial. Trial-by-trial changes in the assignment of CVCs to the four categories precluded perfect performance except by chance; however, with appropriate mediating responses constant from one trial to the next, the theoretical maximum could be increased to about 14 correct responses on each trial.

With the NTR pattern, *S*s were shown the blocks, but *E* did not supply any CVCs. This pattern controlled for transfer from nonspecific sources and provided a baseline to reflect any effects of covert or overt verbalization of pre-experimentally acquired verbal responses.

During acquisition with the fixed or variable patterns, anticipation trials alternated semirandomly with recall trials. For anticipation trials, each of the 16 blocks was presented alone for three seconds; then, as indicated earlier, *E* told *S* the CVC for that block. During anticipation intervals, *S*s under "overt" or "covert" instructions were to say the pre-experimentally acquired characteristic or characteristics aloud or to themselves and then were to give the correct CVC response. For recall trials, each of the blocks was presented alone for three seconds and, during that interval, *S*s under "overt" or "covert" instructions were to say the pre-experimentally acquired characteristic or characteristics of the block in question and then were to recall the correct CVC. The conditions for recall were more similar to those prevailing during block sorting than were those prevailing during anticipation trials. The hope was that prior experience with recall would occasion greater transfer of the responses acquired during the acquisition of the CVC responses. For *S*s under "overt" instructions, *E* recorded *S*s' verbalizations of the characteristics of the blocks and the CVC responses.

With the fixed pattern, the nonsense-syllable responses were learned to a criterion of one perfect trial. The overt-variable combination and the overt-NTR combination were given pretraining trials equal to the mean of the number of trials to criterion for the first five *S*s of the overt-fixed combination. Similarly, *S*s in the covert-variable combination and the covert-NTR combination and those in the regular-varied combination and the regular-NTR combination, respectively, were given pretraining trials equal to the means for the first five *S*s of the overt-fixed combination and of the overt-regular combination. To counterbalance possible differences in *S*s used early or late, five *S*s were run in each of the three fixed-relationship combinations first and last. The means of the numbers of all verbal pretraining trials for the first five *S*s of each combination of fixed pattern and instructions were considered the most convenient way to specify the constant number of trials to be administered *S*s under each of the instructions with variable and NTR patterns.

Each of the six combinations of the three patterns under covert and regular instructions had a terminal trial that involved recall only. Each *S* of the covert-fixed, regular-fixed, covert-variable, and regular-variable combinations was instructed to respond out loud to each block with the name of the characteristics he had used for that block on the trial just preceding and then to give the CVC response assigned to that block.

The *S*s of covert-NTR and regular-NTR combinations were under similar instructions, but did not give terminating CVC responses.

To make the conditions as comparable as possible, *S*s of the three overt combinations also had a terminal recall trial that did not involve additional instructions. During the terminal trial, verbalizations of pre-experimentally acquired names were recorded as were the CVC responses of *S*s with the fixed or variable patterns.

3. *Procedure for Block Sorting*

For each of the four block-sorting trials, a block from each of the height-size categories was placed in a corner of the block-sorting board. The assignment of blocks to the corners was subject to the restrictions that no block in any height-size category be used more than once in the four trials and that no height-size category, as represented by a block, be assigned to any corner more than once in the four trials. The 12 remaining blocks on each trial were presented to *S*s one at a time for placement in the corner that contained one or more blocks that the particular block matched. Intertrial interval and time allowed for placements were not controlled.

The characteristic or characteristics of each block were said out loud before *S* placed the block in one of the corners. Each *S* was told "As soon as you see a block in the window, give it a name telling me what that name is." No changes of placements were permitted, and *S*s were not informed of the correctness of placements. Verbalization of characteristics of the blocks and their placements were recorded.

4. *Subjects*

The *S*s were 90 undergraduates at the University of Massachusetts. The three combinations involving instructions and the fixed pattern were given to *S*s in counterbalanced cycles until five *S*s in each combination had been tested. The remaining six combinations of instructions and patterns were administered to *S*s in counterbalanced cycles until there were 10 *S*s in each combination. Then five more *S*s were added to each of the combinations involving instructions and the fixed pattern, again in counterbalanced cycles. Assignment to each combination was in order of appearance, with the constraint that the number of men or women in each combination be no more than six nor less than four.

C. RESULTS

1. *Acquisition of CVC Responses*

a. Pre-experimentally acquired responses. The pre-experimentally acquired responses of primary interest are those characterizing each block in terms of height and size. Subjects of the overt-fixed combination reached criterion in different numbers of trials. Accordingly, responses referring to height and size (by *S*s for this combination and also by *S*s for the overt-variable combination and the overt-NTR combination) were analyzed only for the first two and last two acquisition trials. During the recall trial, these responses were analyzed for all combinations of instructions and patterns of relationships. Each response referring to the dimensions of height or size or to values along these dimensions was scored as "1." Thus, scores per trial could range from 0 to 32. References to height and size were almost always to the values along these dimensions and invariably were correct designations of these values.

As mentioned previously an *S*, by responding to each block consistently with one response for its value for height and another for its value for size, could reduce to four the number of associations to be acquired. The four would be those between the different stimulus patterns produced by responses referring to combinations of values for height and size and the CVCs. Under overt instructions, such pairs of responses virtually never occurred. For five of the six combinations of covert and regular instructions and patterns, fewer than one of the 16 blocks were referred to by its values for height and for size; for the covert-fixed combination, slightly more than two of the blocks were so characterized. Thus, *S*s did not learn to respond to each block with pairs of responses referring to values for height and size.

Table 1 shows the means of frequencies of all responses referring to height and size. During the first two trials and last two trials under overt instructions, there were 1.8 to 7.2 responses per trial for values of height and size. An analysis of variance shows neither the F of 3.74 ($df = 1,27$) for trials nor the F of 2.82 ($df = 2,27$) for instructions to be significant. The F for their interaction is less than one ($df = 2,27$).

With fixed and variable patterns under overt instructions, more responses referring to height and size occurred during the recall trial than during the last two trials; but the means for these combinations remain below those for the same patterns under covert and regular instructions. The F of 7.49 ($df = 2,81$) for instructions and the F of 7.05 ($df = 2,81$) for patterns are significant beyond the .01 level. The F for their interaction is not significant. Disregarding patterns, the means for overt, covert, and regular instructions were 5.6, 11.9, and 10.9 respectively. Only the difference between 5.6 and 11.9 is significant ($p < .05$). Disregarding instructions, the means for fixed, variable, and NTR patterns were 13.0, 8.9, and 6.5 respectively. Only the difference between 13.0 and 6.5 is significant ($p < .05$).

Frequencies of responses referring to values for shape and for color were

TABLE 1
MEANS OF FREQUENCIES OF ALL RESPONSES PER TRIAL REFERRING TO HEIGHT AND SIZE DURING THE FIRST TWO AND LAST TWO ACQUISITION TRIALS UNDER OVERT INSTRUCTIONS AND DURING THE RECALL TRIAL

Pattern of relationships	Trials	Instructions		
		Overt	Covert	Regular
Fixed	First two	5.0		
	Last two	7.2		
	Recall	8.5	17.0	13.5
Variable	First two	3.6		
	Last two	5.4		
	Recall	6.2	11.6	8.9
NTR	First two	1.8		
	Last two	2.2		
	Recall	2.0	7.1	10.3

much stronger initially than were those referring to values for height and for size. With the fixed pattern under overt instructions, frequencies of pairs of responses referring to values for shape and for color decreased markedly from the frequencies for the first two trials. With the variable patterns, these frequencies decreased; and with the NTR patterns they did not change. Thus, the order of frequencies during the recall trial was as follows: fixed $<$ variable $<$ NTR. During the recall trial under covert and regular instructions, the same order obtained.

b. CVC responses. Means of trials through the criterion trial with the fixed pattern of relationships were 10.2 under overt instructions, 8.9 under covert instructions, and 9.0 under regular instructions. The F for these differences is less than one ($df = 2{,}27$). On the basis of the results for the first five *S*s under these instructions, 11, 12, and nine acquisition trials were administered with variable and NTR patterns under the overt, covert, and regular instructions. All combinations had the additional recall trial.

With the fixed pattern, means of correct CVC responses during the recall trial are 15.0, 8.8, and 11.1 under overt, covert, and regular instructions respectively; with the variable pattern, they are 5.6, 5.6, and 5.1. Significantly more correct responses occurred with the fixed pattern than with the variable pattern [$F = 42.64$ ($df = 1{,}54$)]. The F of 3.76 ($df = 2{,}54$) for instructions and the F of 3.56 ($df = 2{,}54$) for the interaction of patterns and instructions are significant at the .05 level. With the variable pattern, differences among instructions are not significant. With the fixed pattern, significantly more correct responses occurred under overt than under covert or regular instructions and the latter means do not differ significantly.

2. *Block Sorting*

a. Height-size. Table 2 presents the means of correct placements by height and size across the four test trials following acquisition with all three patterns of relationships and the means of correct CVC responses by height and size following acquisition with the fixed and the variable patterns. With the fixed pattern, placements by height and size were nearly always correct following acquisition under overt instructions, correct at a high level following acquisition under covert instructions, and always correct following acquisition under regular instructions. With the other combinations of instructions and patterns (except for the covert-variable combination) placements by height and size were essentially chance.

In the analysis of variance on placements, the Fs for patterns and for the

TABLE 2
MEANS OF CORRECT PLACEMENTS AND CVC RESPONSES BY HEIGHT AND SIZE AND OF CORRECT PLACEMENTS AND VERBAL RESPONSES BY SHAPE AND COLOR

Combination of dimensions	Pattern of relationships	Response	Instructions		
			Overt	Covert	Regular
Height and size	Fixed	Placements	46.7	38.6	48.0
		CVCs	47.1	36.7	45.1
	Variable	Placements	12.2	26.7	11.3
		CVCs	3.3	21.3	12.3
	NTR	Placements	5.5	8.0	13.2
Shape and color	Variable	Placements	27.9	12.9	31.3
		Verbal[a]	41.2	1.4	9.6
	NTR	Placements	36.4	35.9	29.1
		Verbal[a]	88.4	75.5	62.0

[a] Scores for verbal responses referring to values along dimensions of shape or color could range from 0 to 96 in contrast to the possible range of from 0 to 48 for the other scores.

interaction of instructions and patterns are significant. Fewer placements by height and size occurred under overt instructions than under regular and covert instructions. The interaction *F* reflects the slightly lower mean for covert instructions than for overt and regular instructions with the fixed pattern and the higher mean for covert instructions than for overt and regular instructions with the variable pattern. However, none of the *F*s for instructions with each pattern separately is significant. Trials produced no significant *F*s; hence only means for correct placements across all four trials are given.

Table 2 shows the means of correct CVC responses by height and size. With the variable pattern, the CVC response assigned to the blocks of each height and size category during the last anticipation trial of acquisition for each *S* was arbitrarily designated the correct response to those blocks during sorting.

With the fixed pattern, correct CVC responses by height and size continued at or slightly above the levels obtained during the recall trial. With the variable pattern, these responses remained at or fell below the levels obtained during the recall trial. Because the former means were so much larger than the latter, the differences were not tested statistically. With the fixed pattern, means for the different instructions do not differ significantly; with the variable pattern, the mean for covert instructions is sufficiently larger than the means for overt and regular instructions to produce a significant *F*.

CVC responses by height and size are of interest primarily in terms of their relationships to block placements by height and size. With the fixed pattern, six, five, and eight of the *S*s under overt, covert, and regular instructions, respectively, made 48 correct CVC responses by height and size and 48 correct placements by height and size. The other four *S*s under overt instructions, two of the other five *S*s under covert instructions, and one of the other two *S*s under regular instructions were only from one to five responses short of such perfect occurrence of CVC responses, of placements, or of both.

Two of the four remaining *S*s made 24 and 21 CVC responses, all of which were correct by height and size. They were followed by 21 correct placements by height and size. Twelve of the other 24 verbal responses of the first of these *S*s were naming tall large blocks "fat" instead of LAG, and 11 were naming tall small blocks "tall" instead of CEV. Twenty of these 23 responses were followed by correct placements by height and size. The other 27 verbal responses of the second of these *S*s involved substitution of "lucky," "seven," and "cat" for LAG, CEV, and MUR respectively. Blocks given these alternative names were placed together by height and size.

The third of the four remaining *S*s made 12 CVC responses on the first trial, only six of which were by height and size. These responses were not related to placements by height and size. During the last three trials, this *S* used responses of "Jim," "Jane," "Joan," and "Judy." They did not occur in terms of height and size. On 30 of the 36 occurrences of these responses, however, blocks given the same name were placed together.

The last of these four remaining *S*s placed the blocks perfectly by height and size. Her verbal responses were adjectives that she viewed as "imaginative." They did not occur in terms of height and size. Her posttest report indicated that she sorted the blocks by height. Conceivably, responses by height or height and size were made covertly and guided the placements by height and size; while the adjective responses were made overtly to impress *E* with *S*'s "imaginativeness."

With the variable pattern, the data of only one *S* under overt instructions were analyzable in terms of the relationships between CVC responses by height and size and placements by height and size. All CVC responses by height and size occurred only during Trials 2 and 4. They were by height and size and all 24 were followed by correct height-size placements.

Of the eight *S*s in the covert-variable combination who made CVC responses, each of three *S*s made 48 CVC responses which were correct in terms of their assignment to blocks on *S*s' last anticipation trial. All of the placements of these *S*s were perfect by height and size. The remaining five *S*s made 69 CVC responses by the height-size assignment of the last anticipation trial and 171 other CVC responses of which 16 and 45, respectively, were followed by correct placements by height and size. The proportion of blocks named and placed by height and size did not differ from the proportion of blocks not named but placed by height and size.

Six of the *S*s in the regular-variable combination made at least some CVC responses to the blocks. One of the *S*s made 48 correct CVC responses, 42 of which were followed by correct height-size placements. Three of these *S*s named some of the blocks in terms of the height-size assignment of each *S*'s last anticipation trial and then placed the blocks correctly or incorrectly by height and size. Of 55 CVC responses correct for height and size, 30 or 55 per cent were placed correctly by height and size. Of 89 CVC responses that were incorrect, 29 or 34 per cent were placed correctly by height and size. The two remaining *S*s made eight and 12 correct CVC responses, none of which was followed by a correct placement by height and size.

Placements of *S*s given the variable pattern were also analyzed in terms of relationship between blocks given the same CVC name and placed together, regardless of assignment of the CVC responses on *S*s' last anticipation trial. Three *S*s in the overt-variable combination labeled the blocks with CVC responses a total of 119 times. Forty-three or 36 per cent of these involved placing together blocks given the same name. Of the 383 CVC responses by eight *S*s in the covert-variable combination, 346 or 90 per cent were followed by placing like-named blocks together. Six *S*s in the regular-variable condition made 282 CVC responses. Two hundred fourteen or 76 per cent of these involved placing like-named blocks together. For the three instructions conditions combined, blocks given the same name were placed together on 603 or 77 per cent of 784 occasions, which is substantially above the theoretical chance level of 25 per cent.

b. Shape-color. The pre-experimentally acquired names of greatest initial strengths were those for values of shape and color separately or together. Acquisition of CVC responses with the fixed pattern largely eliminated overt use of names for values of shape and color during block sorting. However, with the variable pattern and (even more so) with the NTR pattern, preferences during acquisition with these patterns for describing the blocks in terms of values for shape and color were also apparent during block sorting.

Table 2 presents means of correct placement by shape and color and means of scores for naming the blocks in terms of shape and color separately and together with fixed and NTR patterns. To obtain the latter scores, one point was assigned to each instance in which a block was named correctly in terms of its shape or color. Scores for each block on each trial were "0" for no name or a name other than one referring to shape or color; "1" for reference to shape or color; and "2" for reference to both shape and color. Scores, across all four trials, could range from zero to 96.

Following acquisition with the NTR pattern, slightly less than 75 per cent of the placements were correct by shape and color; while following acquisition with the variable pattern about 50 per cent were correct by shape and color. The F of 36.01 ($df = 1{,}54$) for the difference between these patterns in placements by shape and color is significant at the .01 level (see Table 3).

The Fs for instructions and the interaction of instructions and patterns are also significant. With the variable pattern, the F for instructions is significant; with the NTR pattern, the F for instructions is not significant. Thus, any differences due to instructions are limited to the variable pattern and, more specifically, to fewer placements by shape and color under covert instructions than under overt and regular instructions. There are no significant differences involving trials.

With the variable pattern, verbal responses referring to values for shape and color occurred with appreciable frequency only when acquisition had been under overt instructions. With the NTR pattern, they occurred with high frequencies when acquisition had been under each of the instructions, decreasing slightly in the order overt, covert, and regular. The Fs for instructions and patterns are significant. Despite the apparent differences in the differences among means with the variable pattern and the NTR patterns, the F for the interaction of instructions and patterns is not significant. None of the Fs involving trials is significant.

For all 10 *S*s of the overt-variable combination for acquisition of CVC responses, 130 or 68 per cent of 187 verbal responses in terms of shape and color were followed by placements by shape and color; 149 or 51 per cent of 293 verbal responses not in terms of shape and color were followed by shape-and-color placements. However, *S*s in this combination either labeled all blocks or almost all blocks in terms of values for shape and color or they never did so. The 187 responses in terms of values of shape and color were made by four *S*s; three *S*s always responded in this manner and the fourth *S* did so on 43 of 48 occasions.

Only one *S* in the covert-variable combination responded to the blocks with

TABLE 3
ANALYSES OF VARIANCE ON PLACEMENTS BY HEIGHT AND SIZE AND ON PLACEMENTS AND VERBAL RESPONSES BY SHAPE AND COLOR

	Height and size			Shape and color				
					Placements		Verbal responses	
Source	*df*	*MS*	*F*	*df*	*MS*	*F*	*MS*	*F*
Instructions (I)	2	20.20		2	162.51	5.59**	1285.29	5.45**
Patterns (P)	2	2614.09	60.50**	1	1046.35	36.01**	12571.53	53.30**
I × P	4	134.99	3.13*	2	199.95	6.88**	254.49	1.08
Error (*b*)	81	43.17		54	29.06		235.88	
Trials (T)	3	5.43	2.46	3	5.14	1.17	6.92	1.93
T × I	6	2.56	1.16	3	2.49		2.15	
T × P	6	3.24	1.46	6	3.46		7.28	2.03
T × I × P	12	1.73		6	3.71		1.98	
Error (*w*)	243	2.21		162	4.40		3.58	

* $p < .05$.
** $p < .01$.

pre-experimentally acquired names for the shape and color of the blocks and then only during Trials 1 and 2. Likewise, only one *S* in the regular-variable combination responded in terms of pre-experimentally acquired names for shape and color. There were 48 correct responses by shape and color; all were followed by correct placements by shape and color.

With the NTR pattern, most of the *S*s whose acquisition experiences had been under overt, covert, and regular instructions responded with pre-experimentally acquired names for shape and color. Following acquisition under overt instructions, 340 or 85 per cent of 400 verbal responses by shape and color were followed by placements by shape and color. Of the 80 verbal responses not by shape and color, 23 or 29 per cent were followed by shape-and-color placements. Under covert instructions, 303 or 90 per cent of 326 verbal responses by shape and color were followed by placements by shape and color and 57 or 37 per cent of 154 verbal responses not by shape and color were followed by placements by shape and color. Under regular instructions, 85 per cent (205 of 240) of the verbal responses by shape and color were followed by placements by shape and color and 37 per cent (89 of 240) of the verbal responses not by shape and color were followed by placements by shape and color.

D. Discussion

Occurrences of pre-experimentally acquired verbal responses during acquisition and recall of CVC responses with the fixed and variable patterns and during trials with the NTR patterns are considered. Block sorting is treated in terms of occurrences of pre-experimentally and experimentally acquired verbal responses to the blocks and of placements by height and size and by shape and color. Treated also are relationships between verbal responses and placements. Finally, some implications of the present techniques and findings for the Bourne and Restle, the Bower and Trabasso, and the Levine interpretations of conceptual behavior (1, 2, 9) are mentioned.

1. *Acquisition of CVC Responses*

An important feature of the results for acquisition of new CVC responses is the relative absence of any of the four pairs of pre-experimentally acquired responses referring to values for height and for size of the blocks. Neither initially nor during the course of acquisition did such pairs of pre-experimentally acquired responses occur overtly, and there were no indications of their covert occurrence. Thus, CVC responses to the blocks apparently were acquired by formation of associations between each of the 16 blocks and one of the CVC responses rather than by the formation of only four associations between stimuli produced by the different pairs of responses referring to values for height and for size and different CVC responses.

Under overt instructions, pre-experimentally acquired responses referring to height or to size may have increased slightly in frequency from the first two acquisition trials through the recall trial. Such responses were more frequent during the recall trial under regular instructions and possibly under covert instructions. Responses referring to height or to size were also more frequent with the fixed pattern and possibly with the variable pattern than with the NTR pattern. However, the variable pattern apparently did not force *S*s to use responses referring to height or to size separately or together more often than was the case with the fixed pattern. No general principles that explain the obtained differences due to instructions or to patterns are immediately evident.

Another feature of the results for acquisition of CVC responses is the marked initial frequencies of pairs of pre-experimentally acquired responses referring to values for shape and for color of the blocks. Under overt instructions, marked decrements, slight decrements, and no decrements in frequencies of these pairs of responses occurred from the first two trials to the recall trial with fixed, variable, and NTR patterns. During the recall trial under each of the instructions, the frequencies were in the order: fixed < variable < NTR. Thus, changes from initial hierarchies of responses in terms of values for shape and for color were apparently influenced by instructions and by patterns.

A third feature concerns acquisition of CVC responses with the fixed pattern. Responses referring to characteristics of the block stimuli might have occupied more of the anticipation and recall intervals with overt verbalization under overt instructions than with covert verbalization under covert or regular instructions. Acquisition of the new CVC responses might, therefore, have required more trials under overt instructions than under the other instructions. However, the difference of about one more trial to criterion under overt instructions than under covert or regular instructions did not approach either statistical or practical significance.

The converse relationship held for correct responses during the recall trial with significantly more under overt instructions than under regular and covert instructions. Prior experience in verbalizing the pre-experimentally acquired responses overtly with sufficient speed to permit verbalization of the CVC responses within the three-second anticipation and recall intervals seems a plausible basis of the better recall under overt instructions than under the other instructions. Supporting this explanation is the increase in proportions of correct CVC responses during block sorting for each of the instructions and the nonsignificant differences among these means when *S*s had self-determined amounts of time to name and to place the blocks.

2. *Block Sorting*

The first interesting feature of the results for block sorting is the occurrences of pre-experimentally and experimentally acquired verbal responses. With the NTR pattern, *S*s continued to respond to the blocks in terms of verbal responses by shape and color. With the fixed pattern, pre-experimentally acquired names, whether for shape and color or for height and size, were replaced (substantially or completely) by experimentally acquired CVC responses. Moreover, as stated earlier, the means of correct CVC responses for each of the instructions were higher than they had been during the recall trial. The absence of changes over trials indicates that *S*s did not regress to pre-experimentally acquired responses.

These findings with the fixed pattern, along with the almost complete absence of pairs of responses referring to values for height and for size during acquisition with each of the patterns, are contrary to a suggestion that Lacey and Goss (8) advanced as an alternative to their earlier inferences of mediation of conceptual sorting by experimentally acquired CVC responses. The proposed alternative was mediation of conceptual sorting by pre-experimentally acquired height-and-size responses that had been indirectly activated and strengthened differentially during acquisition of the CVC responses.

With the variable pattern, experimentally acquired CVC responses did not occur as frequently as with the fixed pattern; and pre-experimentally acquired verbal responses by shape and color did not occur as frequently as with the NTR pattern. With the variable pattern, also, differences obtained among instructions. More pre-experimentally acquired responses for shape and color occurred under overt than under covert or regular instructions and more CVC responses occurred under covert than under overt or regular instructions. The former but not the latter differences are significant. Conceivably, *S*s' overt verbalization of responses for shape and color during acquisition of CVC responses produced a stronger tendency to persist in referring to shape and color than did *S*s' covert verbalization of responses by shape and color under covert and regular instructions. The intermediate position of the variable pattern in terms of pre-experimentally acquired responses by shape and color and of experimentally acquired responses during block sorting constitutes further evidence that acquisition with this pattern did not force *S*s into extensive use of pre-experimentally acquired verbal responses by height and size.

Another feature of the results for block sorting was the influence of instructions and patterns on sorting by height and size and by shape and color. With all three instructions, markedly more correct placements by height and size were obtained following acquisition with the fixed pattern than with the variable or NTR patterns. The overall *F* for instructions is not significant and, while the *F* for the interaction of instructions and patterns is significant, none of the *F*s for instructions for each pattern separately is significant. Parenthetically, the requirement of overt verbalization of names during block sorting may have occasioned more correct placements by height and size than had been obtained previously (5, 6, 8) under block-sorting instructions that did not call for verbalization of names either overtly or covertly.

Placements by shape and color were analyzed for instructions combined with variable and NTR patterns. More placements by shape and color occurred with the latter than with the former pattern. Significant *F*s obtained for instructions and for the interaction of instructions and patterns but, at present, the bases for these *F*s do not seem of theoretical or of practical importance.

The third and most important feature of the results for block sorting is the set of relationships between CVC responses by height and size and placements by height and size with the fixed and variable patterns and the relationships between pre-experimentally acquired verbal responses by shape and color and placements by shape and color with the variable pattern and, particularly, the NTR pattern. With the fixed pattern, correct CVC responses by height and size were followed almost invariably by correct placements by height and size. As evidence for mediation of placements by height and size by experimentally acquired verbal responses, these results have only one flaw. They fall too completely in the correct-correct quadrant of a two-by-two contingency table for correct CVC responses by height and size and incorrect responses and for correct placements by height and size and incorrect placements.

With the variable pattern, some evidence was obtained of a positive relationship between CVC responses by height and size in terms of their assignment to blocks during *S*s' last anticipation trial and placements by height and size. The more compelling indication of verbal mediation, however, was that blocks responded to with the same CVC responses were, in general, placed together.

For each of the instructions with the NTR pattern, a positive relationship obtained between pre-experimentally acquired verbal responses by shape and color and placements by shape and color. The less extensive data obtained with the variable pattern also suggested a positive relationship between verbal responses by shape and color and placements by shape and color. Thus, obtained relationships between experimentally acquired CVC responses by height and size and placements by height and size and between pre-experimentally acquired verbal responses by shape and color and placements by shape and color, both indicated verbal mediation of conceptual block sorting. Moreover, such mediation was a complex function of instructions and patterns of relationships.

3. *Implications*

Among current interpretations of conceptual behavior of general interest are those advanced by Bourne and Restle (1), by Bower and Trabasso (2), and by Levine (9). Central to Bourne and Restle's interpretation is the assumption "that irrelevant cues, which are not predictors of reinforcement, become neutralized or adapted" (1, p. 261). Within an analysis of concept formation that includes verbal mediating responses, adaptation of irrelevant cues is partly or entirely attributed to removal of stimuli produced by pre-experimentally acquired verbal responses that refer to irrelevant dimensions or values along those dimensions. Thus interpreted, the novel, essentially inferred phenomenon of adaptation as conceived by Bourne and Restle becomes a consequence of the well-known and observed or potentially observable phenomenon of the weakening of stimulus-response relationships.

Bower and Trabasso's "psychological interpretation of all-or-none models" of concept identification (2) introduces both "perceptual acts (attention) and conditioning of cues to which the subject attends" (2, p. 40). "Perceptual acts" are later made more specific in an assumption that to each particular complex stimulus "a subject gives descriptive names of attributes according to a given hierarchy" (2, p. 83). In the present experiment, occurrences of pre-experimentally acquired names for values of the blocks for shape and color particularly, but also for height and size during acquisition of CVC responses and during block sorting, constitute general justification of this assumption. However, the almost complete replacement of pre-experimentally acquired responses during block sorting by the CVC responses that had been acquired with a fixed relationship complicates Bower and Trabasso's interpretation in at least two ways. First, unless only conventional words for values along dimensions are considered acceptable names for values and combinations of values along dimensions, Bower and Trabasso's distinction between concept selection and concept formation is blurred. Acquisition of the CVC responses and their use in block sorting can be considered "initial development or learning of an equivalence class *de novo*" (2, p. 2) and use of those associations *de novo*. A more general interpretation involves both nonmediational and mediational paradigms. Within each paradigm, an equivalence class might be acquired *de novo* or an "appropriate classification [might be selected] from among a set of attributes known already by the learner."

Second, the theory must be expanded to allow for differential responses to values or combinations of values along dimensions acquired *de novo*. Possibly the parameter r and hence the parameter c would be written as functions of extent and conditions of acquisition of such *de novo* stimulus-response relationships (2, p. 42).

Levine (9) describes "the hypothesis" as his "basic dependent variable. . . . Previously defined as a response pattern, it will hereafter be defined as the *determinant* of a response pattern, as a mediating process which results in the particular response pattern" (p. 255). In practice, each specific hypothesis is either identified by a specific pattern of discriminative responses to values along a dimension of the stimuli or is assigned to a residual category; thus the observational basis for specifying hypotheses remains patterns of motor choices. Specific mediating processes may be inferred from specific patterns; but, in Levine's experiment, the mediating processes, whatever their presumed nature, were not observed directly.

By interpreting the mediating processes as mediating responses, they might be observed directly. Thus, Levine's procedure of a parallel "control" and "experimental" conditions could be modified so that, during nonoutcome trials under a control condition, *S*s make both verbal-choice and then motor-choice responses or only verbal responses. The verbal responses observed directly under the control condition would be the basis of inferences regarding the nature and strengths of the covert mediating responses of *S*s during outcome trials under the parallel experimental condition. Among the advantages of this modification would be more accurate "definition" of residual hypotheses.

A further modification would be to require overt verbal responses of half of the *S*s during outcome trials under an experimental condition prior to the motor choices. Both modifications would permit expansion of Levine's formulation. Moreover, they would place his formulation within analyses of the role of verbal mediation in conceptual behavior more precisely, more explicitly, and more completely.

E. SUMMARY

Occurrences of pre-experimentally acquired responses to values for the height, size, shape, and color of block stimuli were observed during acquisition and recall of CVC responses to the blocks by height and size. The variables were overt instructions, covert instructions, and regular instructions combined with fixed, variable, and NTR patterns of relationships between the blocks and CVC responses. During block sorting, CVC responses by height and size occurred more often with fixed patterns than with variable patterns and were related positively to placements by height and size. Pre-experimentally acquired verbal responses by shape and color occurred more often with NTR than with variable patterns and were related positively to placements by shape and color.

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COMPARATIVE LEARNING IN YOUNG GORILLAS AND ORANG-UTANS*[1]

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A. PURPOSE

An interesting question concerning *Ponginae* has been one of their relative intelligence or learning ability. Relative primitiveness might be expected to correlate with relative intelligence or learning ability; but, according to a leading authority, data are inadequate for ordering orang, chimpanzee, and gorilla on relative primitiveness.[2] Chimpanzee and gorilla are more closely related to each other than either one of them is to orang. Thus differences in intelligence between chimpanzee and gorilla might be expected to be less than those between chimpanzee and gorilla (together) and orang. But the direction, or for that matter the existence of such differences, requires observation. Unfortunately the appropriate literature, although characterized by an increasing number of comparative studies, seldom has included gorilla or orang-utan. The purpose of the present experiment is to provide comparative data on learning ability in young gorillas and orang-utans. Animals were tested on (*a*) patterned-string problems; (*b*) spatial delayed response; and (*c*) non-spatial delayed response.

B. STUDY I: PATTERNED-STRING PROBLEMS

Patterned-string problems can be regarded as a test of perceptual-learning ability. They are a particularly advantageous type of problem because comparative data are available on monkeys (9), chimpanzees (3), and young gorillas (14).

1. *Method*

a. Subjects. Subjects were a pair of preadolescent orang-utans and a pair of younger gorillas, each of whom had had experience with 200 pattern-dis-

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[2] Personal communication from Dr. George G. Simpson.

crimination problems (5). The orangs were a male and a female, whose estimated ages at the beginning of the experiment were 4 years and 6 months and 4 years and 10 months respectively. The younger gorillas were a male and a female, whose estimated ages were 2 years and 6 months and 2 years and 10 months respectively.

Three younger experimentally naive animals were a male gorilla, whose estimated age was 2 years and two infant orang-utans, one a male and one a female, whose estimated ages were less than one year.

b. Procedure. Riesen, Greenberg, Granston, and Fantz have described in detail the apparatus, string problems, and procedure (14). Briefly, the apparatus used was a Klüver-type tray containing a row of screw eyes to which sash cord strings were attached. These strings had snaps at one end (for attachment to the screw eyes) and a hook at the other end (to hold raisin or orange-slice bait). Strings of various lengths and various screw-eye placements made possible the 11 string problems illustrated in Figure 1. Except for the pair of oldest orangs all *S*s were caged separately during testing.

c. Results and discussion. Table 1 shows the number of errors each *S* made in the first 50 and second 50 trials on each of the 11 problems.

The young gorillas, comparable in age to the three young gorillas tested by Riesen, also evidence comparable performance. If 12 or fewer errors in 50 trials is used as a criterion of learning ($\chi^2_{.95}$ with 1 *df*), our subjects, as well as Riesen's, have difficulty with Problems 10 and 11. A discrepancy, however, is that two of our *S*s had at least initial difficulty with Problem 9; whereas two of Riesen's *S*s had initial difficulty with Problem 5. Possibly Problems 10 and 11 are particularly difficult for gorillas, with less difficult problems troublesome for some *S*s only.

Like the gorillas, the orangs had difficulty with Problems 10 and 11; but all except the youngest orang mastered them and had no difficulty with any other problem. The efficiency of the infant orangs is striking. The data, considered with those for the youngest gorilla, imply that for *Ponginae* the perceptual learning necessary for efficiency on patterned-string problems must occur well within the first year of life. More generally, our data appear consistent with those for discrimination learning in neonate monkeys (6) and pattern vision in very young human infants (2); i.e., if form perception is learned (10), learning must occur very rapidly indeed in higher primates.

Although orangs (as a group) are absolutely superior to gorillas on the more difficult problems, neither species effects nor species-by-problems interaction effects prove to be statistically significant sources of variation.

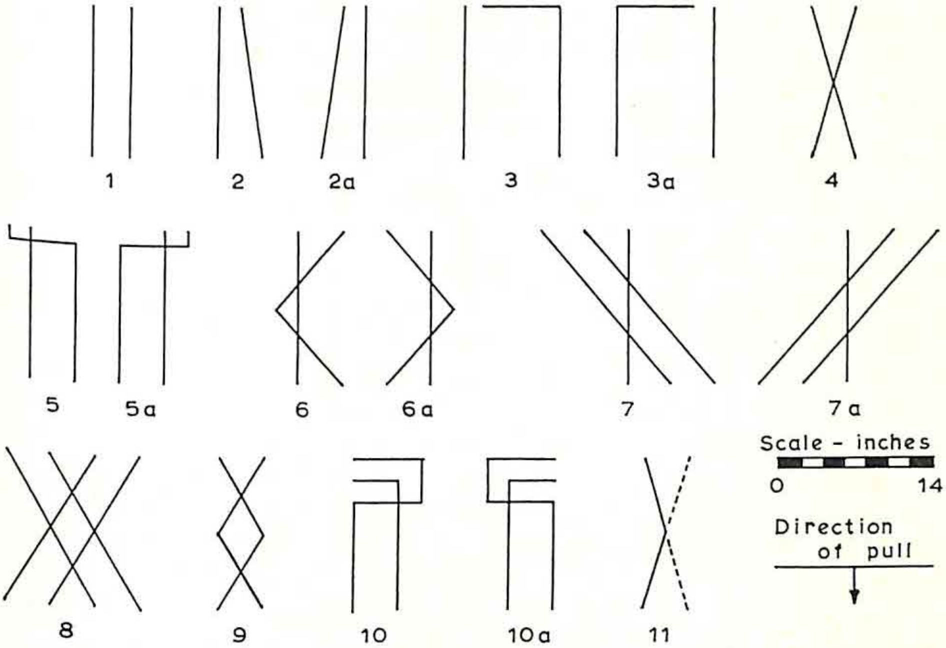

FIGURE 1

THE SERIES OF 11 PATTERNS USED IN THE PRESENT EXPERIMENT

("... after Harlow and Settlage (1934), with Problem 11 added by Finch (1941). Distances between baited ends of the strings were 2 inches in Problems 2, 3, 5, and 10. In all other problems these distances were 4 inches. A distance of 15 inches separated the bait hooks from the row of screw eyes that held the ends of the cords nearest the subject.")[3]

Figure 2 shows the mean per cent of errors per problem for gorillas and orangs, along with Finch's data for adult chimpanzees (3), and Harlow and Settlage's data for adult rhesus monkeys (9). Figure 2 also shows for *Ponginae* the average difficulty of each of the problems, where two or more problems underscored by one line do not differ significantly in difficulty (1). As can be seen, absolute differences between chimpanzees and gorillas or between chimpanzees and orangs are less than those between gorillas and orangs. Thus the data imply that patterned-string problems do not differentiate *Ponginae*. The more difficult problems (i.e., the complex cross and the pseudocross), however, may differentiate *Ponginae* from monkeys. Such a conclusion is supported by the data in Figure 2 and by the efficiency of the young gorilla and infant orangs, in contrast to the relative inefficiency of infant rhesus on crossed and pseudocrossed string problems (11).

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[3] Reproduced from Riesen *et al.* (14) by permission of Dr. Riesen and the *Journal of Comparative and Physiological Psychology.*

TABLE 1
NUMBER OF ERRORS IN SUCCESSIVE SETS OF 50 TRIALS ON PATTERNED-STRING PROBLEMS

	Gorillas						Orang-utans							
	Sheba (32 mos.)		Solomon (30 mos.)		Moe (24 mos.)		Ching (54 mos.)		Lotus (58 mos.)		Male (9 mos.)		Female (11 mos.)	
String problems	1-50	51-100	1-50	51-100	1-50	51-100	1-50	51-100	1-50	51-100	1-50	51-100	1-50	51-100
1	2	0	11	0	1	1	1	0	0	0	8	3	3	0
2	2	0	0	0	1	4	0	0	0	0	0	1	0	0
3	0	1	0	0	1	0	1	0	0	0	4	6	1	0
4	8	8	14	5	2	6	2	2	8	0	1	2	1	0
5	5	1	7	4	4	3	2	2	1	0	4	1	1	0
6	10	5	16	11	3	3	8	2	9	2	20	16	6	1
7	0	5	5	0	4	2	1	0	1	1	21	7	1	0
8	3	2	9	0	2	3	0	0	0	0	4	0	6	1
9	16	8	24	18	10	2	3	1	1	2	2	1	0	1
10	21	21	19	27	20	14	13	1	12	2	24	17	13	6
11	11	3	22	0	39	37	14	5	17	4	2	1	18	7
Total	78		127		87		45		49		90		50	

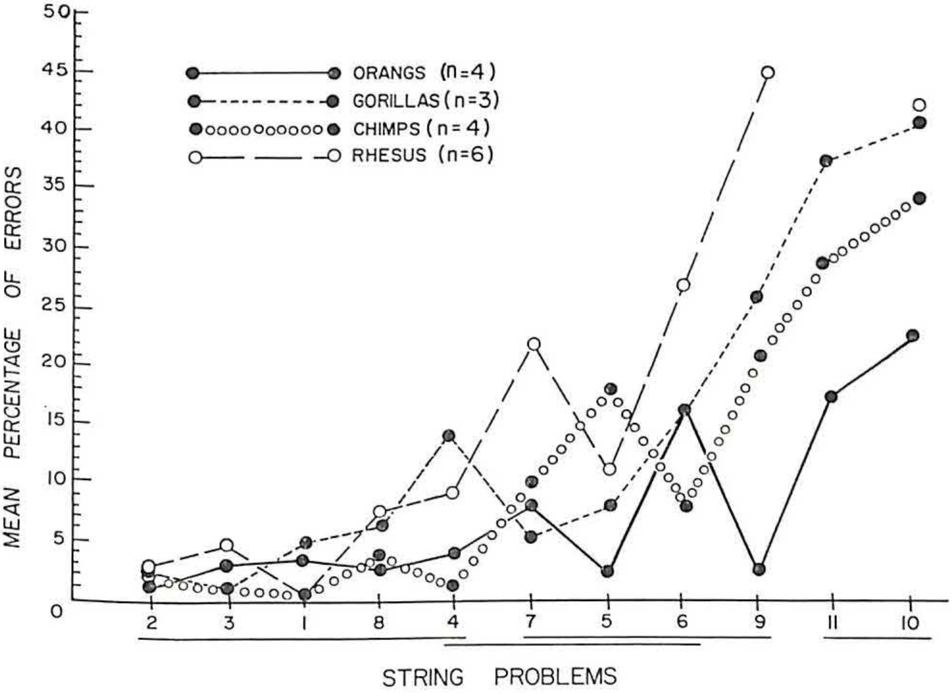

FIGURE 2
THE MEAN PERCENTAGE OF ERRORS ON STRING PROBLEMS BY SPECIES OF PONGINAE AND THE RHESUS MONKEY
(Data on adult chimps are from Finch (3). Adult rhesus data are from Harlow and Settlage (9).)

A final possibility tested was that *Ponginae* might differ on learning within trials per problem (i.e., early trials *versus* late trials), but a subject within species-by-problems-by-blocks of trials, repeated-measurements analysis of variance failed to reveal species differences. Block effects *per se,* however, were significant. On the later trials errors, on the average, were 50 per cent less than on the early trials. Clearly, *Ponginae* are capable of learning within-string problems.

C. STUDY II: SPATIAL DELAYED RESPONSE

Nissen, Riesen, and Nowlis have described the delayed response as a series of learning and retention trials (13). Because trials usually are repeated presentations of the same stimuli, it seems further that learning and retention of the correct "place" is a function of perception and immediate-memory span.

As immediate-memory span varies with intelligence among humans, one might expect performance on delayed-response-learning tasks to differentiate species.

From comparative data on spatial delay in marmosets and rhesus macaques, Miles (12) has found marmosets to be inferior to rhesus macaques in early trials on all delays greater than one second and in final trials on 16-second delays. The present study replicates Miles' procedure, but used longer delay periods.

1. *Method*

a. Apparatus. The apparatus used was a Klüver-type tray with two food wells, two and one-quarter inches in diameter and 12 inches apart. Stimuli to be displaced were two identical red, wooden, isosceles triangles.

b. Procedure. Subjects were given 100 pretraining trials with a zero-second delay. On the pretraining trials, as well as on the test trials, stimuli were pulled back from the food wells, bait was held between the stimuli in view of the subject for three seconds, and then placed randomly in one of the food wells. Both wells were immediately covered with the stimuli, and the tray was pushed toward the animal.

After preliminary training, subjects were given 225 trials for each of six delay intervals: 0, 4, 8, 16, 32, and 64 seconds. With the restriction that all six delay intervals be presented before any one interval was repeated, the six delay intervals were presented randomly over trials. A total of 25 trials was given in each of two daily test sessions.

c. Results and discussion. The per cents of responses correct in each successive block of 75 trials for each of the six delay intervals were transformed to 2 arc sin $\sqrt{p}$ and subjected to a subjects within species-by-delays-by-blocks of 75 trials, repeated-measurements analysis of variance. The results are given in Table 2 and Figure 3.

With delays exceeding four seconds performance drops for both species of *Ponginae*. But the slope is steeper for gorillas than for orangs; that is, the orangs' superiority increases with increased delay intervals. Analysis of variance of simple effects in the subjects-by-delays interaction shows that orang superiority is statistically significant for an eight-second delay and becomes increasingly significant as delays increase to 64 seconds.

As is the case with patterned-string problems, both species give evidence of learning as testing progresses. The amount of learning or improvement on successive blocks of trials, however, varies with delay intervals and species (see Table 2). Figure 4 shows the blocks-by-delays-by-species effect. Both species show relatively less learning on shorter delays than on longer delays because both species are efficient to begin with. But where orangs show learn-

TABLE 2
ANALYSIS OF VARIANCE IN TRANSFORMED PERCENTAGES OF CORRECT RESPONSES ON SPATIAL DELAYS

Source of variation	Sum of squares	*df*	Mean sum of squares	*F*
Species	1,529.04	1	1,529.04	85.96*
*S*s in species	35.75	2	17.87	
Delays	6,433.38	5	1,286.68	133.33**
Delays by species	946.59	5	189.32	19.62**
Delays by *S*s in species	96.49	10	9.65	
Blocks	424.92	2	212.46	2.16
Blocks by species	13.09	2	6.54	0.07
Blocks by *S*s in species	394.23	4	98.57	
Blocks by delays	209.09	10	20.91	5.29**
Blocks by delays by species	457.01	10	45.70	11.57**
Blocks by delays by *S*s in species	79.07	20	3.95	
Total	10,618.66	71		

* $p < .05$.
** $p < .01$.

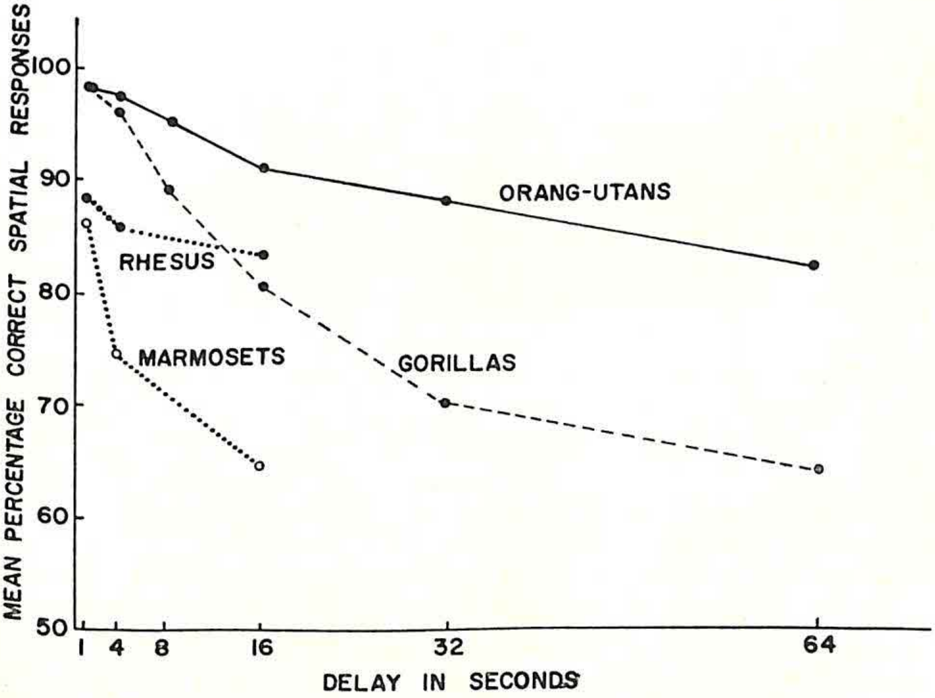

FIGURE 3
MEAN PERCENTAGE CORRECT RESPONSES IN 225 TRIALS AT EACH SPATIAL-DELAY INTERVAL
(Data on Rhesus and Marmosets Taken from Miles (12).)

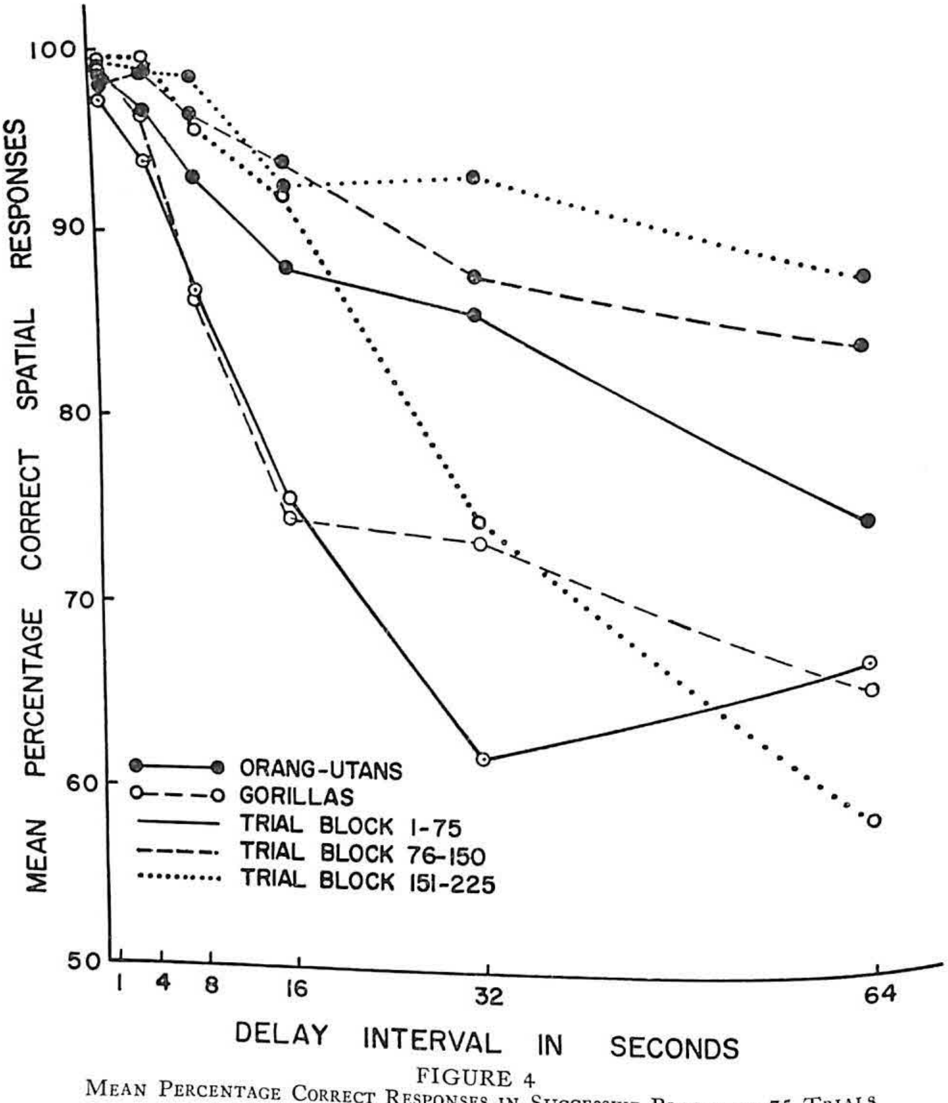

FIGURE 4
MEAN PERCENTAGE CORRECT RESPONSES IN SUCCESSIVE BLOCKS OF 75 TRIALS AT EACH DELAY INTERVAL

ing from block to block on all delays, gorillas show most of their learning during the last block of trials and no learning at all on the longest delay (64 seconds). Finally, the orangs' performance on all spatial delays within 225 trials is strikingly efficient. Gorillas, although initially inferior to the orang, match the orang's efficiency within 225 trials on delays up to and including 16 seconds; but they remain less efficient than do orangs on delays greater than 16 seconds.

One might think that orangs are less distractible or more patient than gorillas and, for that reason, perform better on longer delays. The two species, however, do not differ in the number of trials on which they left the apparatus and do not differ in the per cent of errors on such trials.

The relatively later learning by gorillas implies rather that their initial inferiority may be a function of age. (The gorillas tested were younger than the orangs.) The foregoing implication is supported by data on adult rhesus monkeys (12). Adult rhesus show the greatest improvement on 16-second delays on the second block of trials; the younger gorillas in the present study show the greatest improvement later (the third block of trials). Further, infant rhesus monkeys take a long time to reach near-adult levels on five-second delays (8). In other words, the younger animal seems to require more practice on spatial delays than does an older animal. Thus the younger age of the gorillas cannot be discounted as an explanation of their failure to match orang performance on longer delays. Still the rather striking efficiency of the orangs suggests to the authors that the orang surely need not be considered inferior among the *Ponginae*.

The adult rhesus monkey seems to perform about as well as do young gorillas through 16-second delays (see Figure 3). At a developmental age roughly comparable to that of the gorillas in the present study, rhesus monkeys are found to perform with 40-second delays well beyond chance expectation (8) within about the same number of trials that gorillas need; yet, as suggested, the gorillas' performance in the present study may be seriously underestimated by their younger age. One should remember, also, that a laboratory setting seems to favor delayed-response learning (see 7).

D. STUDY III: NONSPATIAL DELAYED RESPONSE

For primates, the nonspatial delayed response is more difficult than spatial delay, and thus holds particular promise for revealing species differences if such differences exist. We used the traditional technique for investigating nonspatial delay in primates: i.e., delayed matching from sample (15).

1. *Method*

a. Apparatus. The test tray contained three two and one-quarter-inch food wells separated six inches from center to center. Each well was hidden by a door that could be raised alone or in combination with other doors. The center well was always used for presentation of the sample stimulus (4). Test stimuli were two two and one-half inch by two and one-half inch black aluminum cylinders mounted on a three-inch square base, and two two and one-half inch by two and one-half inch white aluminum crosses similarly mounted.

b. Procedure.

(1). *Matching from sample.* First, the subjects were taught to displace either stimulus object to obtain bait when the center door was raised. Then matching-from-sample training was initiated: bait was placed under the sample object and under one like the sample object, and the remaining unbaited well was covered by the stimulus object unlike the sample. The center door was then raised to allow the subject to displace the sample and procure the bait. Next, the remaining doors were raised to allow the subject to displace one of the two adjacent stimuli. Within each test session, one of the two stimuli was randomly selected as the sample (with the restriction that each stimulus be used an equal number of times). Similarly, the stimulus like the sample was randomly placed over one of the remaining two wells an equal number of times. Each subject was tested until he achieved an accuracy score of 90 per cent in a 50-trial session. The authors had intended to continue training until each subject had received the same number of trials, but this intention could not be executed.

(2). *Delayed matching from sample.* The procedure for delayed matching from sample differed from the procedure for matching from sample in only two respects. First, after the sample was displaced the center door was lowered, so that the sample was not visible to the subject when he subsequently made his matching choice. Second, six delay intervals (2, 4, 8, 16, 32, and 64 seconds) were randomly applied to the interval between lowering the center door and raising the two adjacent doors. As in the spatial delay procedure, all six delay intervals were given before any one was repeated; and each delay interval was presented for a total of 225 trials.

c. Results and discussion. On matching from sample, the male and female orangs reached 90 per cent accuracy in a 50-trial session within 200 and 500 trials respectively. The male gorilla reached that same criterion within 450 trials. Both gorillas gave evidence of strong and persistent position preference. That of the female was so persistent, however, that after 500 trials it was deliberately altered to facilitate learning. Because regression to stereotypy persisted, however, the female gorilla finally reached 90 per cent accuracy only after 1000 trials. The other subjects were given no more than 600 trials.

Table 3 shows for each subject the per cent of correct responses at the various delay intervals. As can be seen, subject-to-subject variability is greater than it is on the spatial-delay learning, and overall efficiency is less. In fact, even with slight increases in delay, efficiency appears to drop off sharply. Only the male orang achieves an above-chance learning on delays longer than eight seconds. The highly inefficient performance of the female gorilla stands out, possibly as a result of the difficulties in her training. In view of all the foregoing factors, pooling of the data for analysis is inappropriate; but we do note that the orangs maintain their absolute superiority.

TABLE 3
PERCENTAGE OF CORRECT RESPONSES ON NONSPATIAL DELAYS

	Orang-utans		Gorillas	
Delays	Ching	Lotus	Sheba	Solomon
2	95.1	77.8	65.7	71.1
4	92.9	75.6	55.1	60.4
8	85.3	61.3	54.2	58.2
16	76.0	52.9	52.9	53.8
32	68.9	51.6	52.0	56.0
64	56.9	61.7	62.4	60.4

E. CONCLUSIONS

Other than for slight difficulty with complex-string and pseudocrossed-string problems, young gorillas and infant orangs perform efficiently on patterned-string problems and give evidence of within-problem learning. Their ability appears comparable to that found for chimpanzees and superior to that of rhesus monkey on (at least) the more difficult string problems. Young gorillas and orang-utans are also capable of efficient performance on spatial-delayed response and learn as testing progresses. In the present study orangs were initially superior to the younger gorillas on delays as long as eight seconds and remained superior on delays longer than 16 seconds. Distractibility can be ruled out as contributing to gorilla inferiority, but their younger age cannot.

In comparison to spatial-delay performance, performance by young gorillas and orangs on nonspatial delay increases in variability and decreases more rapidly in efficiency. Whereas young *Ponginae* can perform efficiently on spatial delays as long as or longer than a minute, they are not likely to be able to perform on nonspatial delays longer than 16 seconds. They learn and remember "where," but do not seem to remember "what."

Of the tests utilized, complex-string and pseudocrossed-string patterns and (in particular) spatial-delayed response seem the most promising for assessing possible species differences among *Ponginae;* although the sensitivity to age differences of the spatial-delayed response would require control. Our results do not support differences in learning ability between young gorillas and orang-utans.

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SOCIAL DOMINANCE AND SUBORDINATION IN THE RAT AS A FUNCTION OF POSTWEANING ELECTRICAL STIMULATION*[1]

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A. INTRODUCTION

The experimental study of the effects of early stimulation is barely more than a decade old; yet a substantial array of research points to the conclusion that early stimulation can have lasting effects upon the immature organism in a variety of response systems (7, 13, 14, 15, 23, 25). Moreover, although tactual stimulation or "gentling" has been the typical form of discontinuous stimulation used, it seems that the effects are independent of the mode of stimulation. Electric shock seems to have the same effects as handling (15), as does shaking of the home cage (16) and tossing the young into the air and catching them (1). With regard to emotional reactivity to stress, recent experiments at the physiological level (14) indicate that animals not subjected to extra stimulation early in life are hyperreactors in that they (*a*) react to a greater variety of changes in the environment, (*b*) require less-extreme changes to elicit a stress response, and (*c*) show a more-sustained reaction, once it is elicited. It would not be surprising, then, to find that animals in which greater emotional control has been effected through extra stimulation early in life have the advantage in social situations evoking a stress response, such as those in which organisms compete for the recognition of food or other priorities. This hypothesis has been tested and confirmed in the rat with respect to tactual stimulation administered during the postweaning period (22) and in infancy (20). The present paper concerns the functional equivalence of various modes of stimulation in the facilitation of the learning of social-dominance habits in the rat.

B. EXPERIMENT 1

The initial experiment of the present investigation tested the hypothesis that electric shock administered during the postweaning period in the rat produces differences in social dominance similar to those effected by tactual stimulation.

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[1] This report is based on the dissertation (4) submitted to the University of Pittsburgh in December, 1963, in partial fulfillment of the requirements for the Ph.D. degree in Psychology.

1. *Method*

a. Subjects. Eight male Sprague-Dawley albino rats, all of the same litter, were weaned at 21 days of age and put into separate cages. They were randomly divided into two groups of four each: an experimental group and a control group.

b. Apparatus. The electrical-shocking apparatus consisted of the white compartment of a Miller Box (21). Briefly, the compartment was 18 inches long, six inches wide, and eight and one-half inches high. Shock could be administered through the grid floor of the compartment. The compartment had a plexiglass front, which enabled *E* to observe the animal's behavior, and a hinged wire-mesh top. The other compartment of the box was not used.

The apparatus used for testing dominance [*see* Figure 1] is functionally

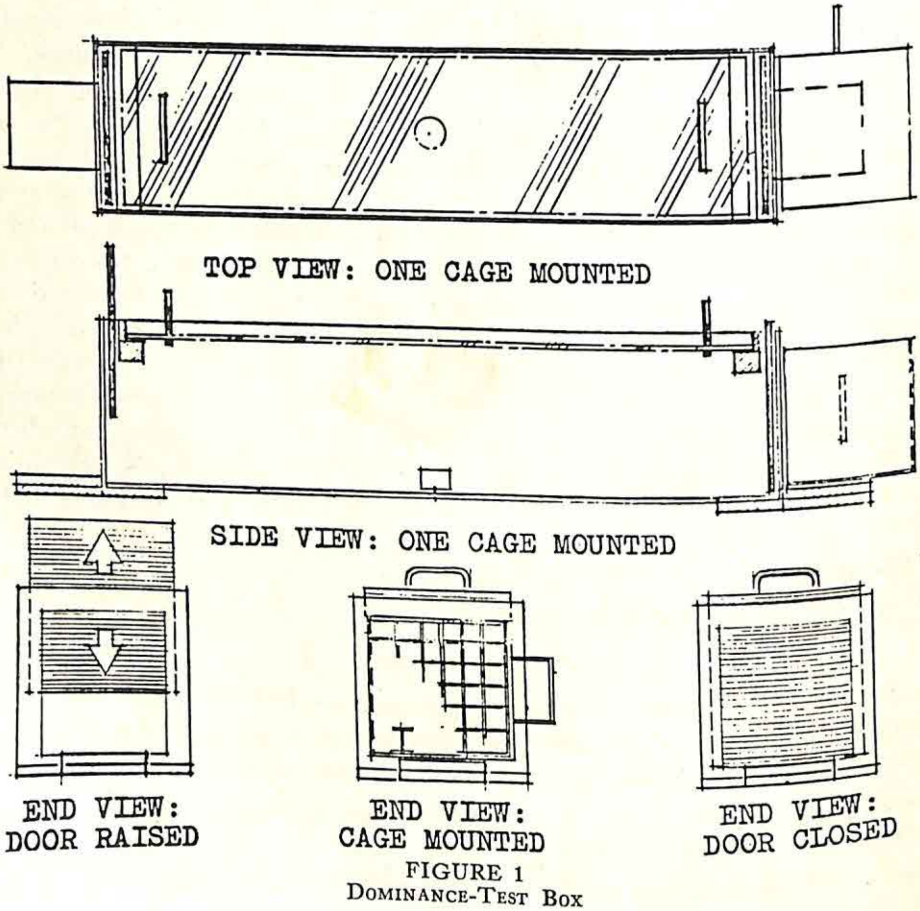

FIGURE 1
DOMINANCE-TEST BOX

similar to the ones used by Rosen (22) and Uyeno (26). It was rectangular in shape: 3′5″ long, 9¾″ wide, and 10½″ high. The floor and sides were of unpainted pine wood. Both ends were closed by guillotine doors made of beaverboard; the removable top was made of plexiglass. At both ends of the box on the outside of the doors was a wooden platform (six inches wide) extending outward five inches, on which a home cage could be rested on its side such that when the door was raised, the rat in the cage would have access to the contents (wet mash) of a plastic cylindrical container (one-inch high and one and one-quarter inches in diameter), which had been screwed to the center of the floor.

c. Procedure. Experimental *S*s were shocked individually twice a day for 20 days starting on Day 18. Shock was delivered on a one-minute-on-one-minute-off routine over a nine-minute period, the total shock time being five minutes per session or 10 minutes per day. The on-off alternation served the purpose of minimizing the learning of position habits that would permit *S* to escape or avoid shock. (A grid scrambler was not available.) Voltage was first set at 55 and increased at intervals to a maximum of 104, for the purpose of offsetting accommodation to the current. The circuit included a 20-kilohm resistor to reduce variation in current because of differences in body resistance over *S*s and over time. Control *S*s were neither shocked nor handled during this period.

To familiarize *S* with the dominance-test box and the position and contents of the plastic container, the following process was instituted. A home cage was placed on its side on one of the cage platforms chosen at random, permitting *S* to pass through the raised door, explore the box, and ultimately eat the wet mash placed in the food container. The familiarization process was started on Day 38. It consisted of one five-minute trial each day and continued for 11 days. On the last trial, all *S*s had latencies of less than .03 minute in reaching the food container.

Dominance testing began on Day 49 and continued for seven days (competition set)—the time necessary for a complete round of 12 intragroup and 16 intergroup pair comparisons at the rate of one competition per day per *S*. Each competition lasted five minutes. A second competition set was begun on Day 124 in order to determine the reliability of individual differences in dominance found in the first set, and a third competition set followed immediately thereafter on Day 131 in order to determine the reliability of the second set. On a given competition, two home cages with occupants were placed one on each cage platform. The guillotine doors were raised simultaneously, permitting both *S*s to approach the food container with equal advantage and compete for the wet mash available only to one *S* at a time because of the small diameter of the food container. Separate stop watches were used for each *S* to record the accumulated time spent at the food container during the five-minute period. *S*s' tails were colored to facilitate identification during encounters.

*S*s were fed ad libitum from weaning through Day 37 at which time all food was removed and a deprivation schedule begun. The schedule permitted *S* 15 grams of Purina Chow per day in pellet form or pulverized with water added to create wet mash. The food container was estimated to need seven grams of powdered food added to water to make enough wet mash (20 grams) to fill the food container. From this information, it was estimated how much food was eaten during a dominance-test-box familiarization or competition trial, and pellets were given after the home cage was returned to the rack, so that total daily consumption always approximated 15 grams.

Between the first-competition set and the second-competition set, both groups were tested on additional behavior, for reasons beyond the immediate purpose of this paper. Food-pellet-hoarding trials one-half hour each were arranged once a day over an 18-day period in the dominance-test box into which a portable fixture was fitted in accord with the needs of testing. When the hoarding trials were finished, 15-minute exploration trials were given daily for nine days in a modified open-field box containing nine partially closed but accessible compartments. The findings on hoarding and exploratory activity will not be reported in this paper; however, the additional stimulation from these experiences has theoretical relevance and will be discussed at the appropriate time.

2. *Results*

The results are summarized in Table 1. Contrary to expectation, the shocked *S*s spent a smaller proportion of the five-minute periods at the food container, on the average, during the first (preadolescent) competition set and won only two of 16 intergroup encounters. A win was defined as a bout in which *S* spent a greater proportion of the time at the food container than did his competitor. The second set, after an interval of almost 10 weeks during which one control *S* died, revealed a complete turnabout. This time, the shocked *S*s spent more time at the food container and won 10 of 12 intergroup contests. Of particular interest, is the finding that the least dominant *S* and the next-least dominant *S* in the first set became the most dominant *S* and the next-most dominant *S*, respectively, in the second set. The rank-

TABLE 1
MEAN PERCENTAGE OF EATING TIME AND NUMBER OF WINS

Competition set	N	Intergroup and intragroup competitions Mean %	Wins N	Intergroup competitions Mean %	Wins N
First-competition set					
Days 49 to 55					
Experimental	4	41.1**	8	34.5	2
Control	4	58.9	20	65.5	14
Second-competition set					
Days 124 to 130					
Experimental	4	59.5	16	68.6	10
Control	3[a]	40.5	5	31.4	2
Third-competition set					
Days 131 to 137					
Experimental	4	65.5*	17	81.3	11
Control	3	34.5	4	18.7	1

[a] One control S died.

* Difference between means for experimental and control groups significant at .10 level.

** Difference between means for experimental and control groups significant at .05 level.

difference coefficient of correlation between the two sets is —.83 ($p < .10$). The coefficient between the second and third sets is .89 ($p < .05$), indicating a high degree of stability of individual differences in status during adult testing.

3. *Discussion*

The results obtained during adult testing may be interpreted as consistent with the hypothesis tested. The preadolescent inversion, however, was entirely unexpected. A recent study by Lindholm (17) permits speculation on the nature of the inversion. According to Lindholm, there are two hypotheses concerning the effects of early aversive stimulation upon adult emotionality. The first is that stimulation *decreases* susceptibility to later emotional disturbance through physiological adaptation. This function was discussed at the beginning of the present paper. The second hypothesis is that stimulation *increases* later emotional disturbance (10, 18, 19), possibly through the classical conditioning of fear responses to the original or generalized conditioned stimulus (3). Lindholm demonstrated that early aversive stimulation can produce a conditioned emotional response to a conditioned stimulus and simultaneously reduce emotional disturbance to other stressful stimuli. He gave young rats electric-shock trials accompanied by a bright light and the sound of a buzzer and found in later testing (*a*) that *S*s when placed in the same shock apparatus with light and buzzer on but with the current off did not respond differentially from controls (in terms of defecation and urination) if the early shock treatment was given before 21 days of age, (*b*) that *S*s when tested in the same apparatus under the same conditions were more emotional (as indicated by defecation and urination) than controls if the early shock treatment was given from 21 days through 30 days of age, and (*c*) that *S*s when placed in a novel apparatus for testing water-reaching latencies were less emotional (as indicated by smaller latencies) than controls whether the early shock treatment was given before or after 21 days of age. Lindholm concluded that each effect had a critical period and that the two periods varied. The conditioned emotional response was producible from 21 days to 30 days of age and not earlier. A similar finding has been reported in mice (6). On the other hand, physiological adaptation due to shock experience was most readily incurred from 11 days to 30 days of age in reducing susceptibility to later emotional disturbance.

Although the experimental *S*s in the present experiment were not exposed to such a highly differentiated stimulus as a bright light or the sound of a buzzer during shock trials, they were exposed to a variety of stimuli, such as those associated with being in a brighter area than the cages in which they were living or with being in an unfamiliar place. Such associations, introduced during the postweaning period, may have been sufficiently strong to produce the preadolescent inversion found in the first competition set due to a disorganizing conditioned emotional response to stimuli introduced when in the dominance-test box and which were similar to those in the shock apparatus. The conditioned emotional response may have extinguished or counterconditioned during the hoarding and exploration trials. If so, the shocked *S*s would have been able to manifest their potential for decreased susceptibility to emotional disturbance in superior competitive ability. If such be the case, it seems that those individuals most easily conditioned are those who most easily adapt physiologically, in view of the high negative coefficient between the first and second sets.

C. Experiment 2

The second experiment to be reported in the present paper attempted to answer six questions arising from the findings in the first experiment, namely: (*a*) Can the results obtained during preadolescent dominance testing and adult dominance testing be replicated? (*b*) Which variable is responsible for the resolution of the preadolescent inversion? Or, in terms of the speculation discussed, is it the interpolated experience of hoarding and exploration? (*c*) Is the resolution of the inversion dependent on prior competition experience? That is, do the adult tests conform to expectation in the absence of the preadolescent encounters? (*d*) Would the resolution be inhibited if the competitions continued without rest intervals into adulthood? It is known that the continuous experience of defeat can reduce the winning potential of an animal (8, 12, 24). (*e*) How soon does resolution occur? That is, regardless of the factor responsible for resolution, would one-half the time period permitted in the first experiment be sufficient for it to become effective? (*f*) Is it necessary for *S* to receive shock treatment early in life, as was the case in the first experiment? or does similar treatment in adulthood produce a similar effect?

1. *Method*

a. Subjects. Ninety-eight male Sprague-Dawley albino rats, born of 22 litters, were the subjects. The mothers, bred at Charles River Breeding Laboratories and delivered when pregnant about two weeks, were placed in individual cages containing a fine wire-mesh insert secured to the inside of the floor and covered with shavings. All litters were born in a 48-hour period, but for convenience in designating age all offspring were considered to have been born during the second half of that period. At 20 days of age, all offspring were weaned; and the males were placed into individual cages. The females were not used in this experiment. Later in the day, electrodes (which will be described in the apparatus section) were implanted in the loose skin on the back of the neck of each of one-half of the males.

*b. Groupings. S*s were divided into seven groups of 14 each and further divided into subgroups of seven each, according to the method of split litters. The experimental subgroup was given shock treatment; the control subgroup remained in the home cage and was neither shocked nor handled till the time of dominance testing (except when being weighed). The overall procedure consisted of three phases: (*a*) shock or no shock, (*b*) dominance-test box familiarization, and (*c*) dominance testing. The differences in procedure among the seven groups were based on four factors: (*a*) the number and distribution of dominance tests, (*b*) the age at which the experimental subgroups were shocked, (*c*) the presence or absence of extra stimulation resulting from hoarding and exploratory activity, and (*d*) the distribution of rest periods. The arrangement of the four factors characteristic of a given group is diagrammed in Figure 2 and forms the basis for the abbreviated name of that group, as explained in the caption. The seven groups are as follows:

GROUP	PERIOD OF LIFE					
	Postweaning	Preadolescence	Postadolescence	Adulthood		
	← - -SERIES A- - →				←SER.B→	← SERIES C →
1. STET	S	T	E	T	T T T T	T T T
2. STXT	S	T	X	T	T	
3. STTT	S	T	T	T	T	
4. SXXT	S	X	X	T	T	
5. SXTT	S	X	T	T	T	T T T
6. ST → T	S	T T T T T T T T		T	T	T T T
7. XXST	X	X	S	T	T	

FIGURE 2

Diagram Indicating Group Differences in Number and Distribution of Dominance Tests (T), Age at Which the Experimental Subgroups Were Shocked (S), the Presence of Extra Stimulation Resulting from Hoarding and Exploratory Activity (E), and the Distribution of Rest Periods (X)

(Group abbreviations are taken from the sequence of these four factors characteristic of the group; for example, the STET (extra-stimulation group) is characterized by postweaning electrical stimulation, preadolescent-dominance testing, postadolescent hoarding and exploratory experience, and adult-dominance testing. The sequence of factors, in abbreviated form, is S—T—E—T or STET. The patterns of further adult testing are seen in Series B and C. STXT = no-extra stimulation group, STTT = midway-dominance-test group, SXXT = no-preadolescent-dominance-test group, SXTT = postadolescent-dominance-test group, ST → T = continuous-dominance-test group, XXST = late-shock group.)

(1). *The extra-stimulation group.* The experimental subgroup was given postweaning electrical stimulation on Days 21 through 38. Dominance-test-box accommodation for both subgroups was started on Day 39 and lasted through Day 47. The first-competition set was begun on Day 48 and ended on Day 54. On Day 58, through Day 75, a one-half hour hoarding trial and on Day 87, through Day 94, an eight-minute exploration trial were given both subgroups. On Day 104, a second-competition set was begun. This group tested the replicability of the findings in the first experiment.

(2). *The no-extra-stimulation group.* This group was treated in the same way as the extra-stimulation group except that hoarding and exploration were omitted. This group tested whether or not preadolescent inversion can be resolved in the absence of the hoarding and exploration trials.

(3). *The midway-dominance-test group.* This group was treated in the same manner as the no-extra-stimulation group but with an additional competition set inserted midway beginning on Day 76. This group was formed to determine whether or not the inversion resolves itself after a three-week rest interval.

(4). *The no-preadolescent-dominance-test group.* This group was treated like the no-extra-stimulation group except that the preadolescent dominance test was omitted. This group was formed to determine the necessity of prior-and-preadolescent-competition experience for the inversion resolution.

(5). *The postadolescent-dominance-test group.* This group was treated like the no-extra-stimulation group except that a competition set starting on Day 76 substituted for the preadolescent competition set. This group tested whether or not prior competition experience, if found necessary for the inversion resolution, need occur only during the preadolescent period.

(6). *The continuous-dominance-test group.* This group started competing on Day 48 and continued through nine continuous competition sets lasting nine weeks. Such a group tested whether or not the continuous experience of defeat on the part of the experimental *S*s precludes the expected resolution.

(7). *The late-shock group.* The experimental subgroup was given shock treatment for 18 days beginning on Day 77. This treatment was followed immediately by Dominance-test-box familiarization starting on Day 95, and dominance testing started on Day 104. This group tested whether or not shock treatment given only early in life can be effective in determining social status.

The foregoing series of competition sets were designated as Series A and were followed by Series B and C, which will be described later.

c. Apparatus. Because of the large number of *S*s to be shocked, a special eight-compartment rectangular shock box was constructed. Each compartment was eight inches long, eight inches wide, and 14 inches high. The partitions, backs, and ends were made of unpainted plywood. Each compartment shared a common plexiglass front and had an individual hinged plexiglass top. To eliminate the learning of position habits possible on a grid floor, the circuits were in parallel; and any given one of the eight subcircuits was completed when the electrode secured to the neck of each animal was connected to the lead which passed through a hole in the plexiglass top and when the rat made contact with the floor of hardware cloth. Each of the overhead leads included a 100-kilohm resistor to minimize variations in current due to differences in body resistance over *S*s and over time.

The electrodes were simple one and one-sixteenth inch stainless-steel safety pins, with male dress snaps soldered to the center of the outside of the half containing the head. To the lower end of the overhead lead was soldered the pointed end of a common straight pin, which had been passed through the opening of a female dress snap which easily accommodated the electrode. To permit maximal freedom of movement for the rat, a second dress-snap arrangement was introduced at the top of the overhead lead one inch below its contact with the plexiglass top.

The same apparatus used for testing dominance in Experiment 1 [*see* Figure 1] was used in the present experiment. The same hoarding and exploration apparatus mentioned earlier were also used again.

d. Procedure. Experimental *S*s were shocked twice a day for 18 days. The one-minute-on-one-minute-off schedule reported in Experiment 1 was used again purely for purposes of standardization. For the experimental *S*s in the six early-stimulation groups, a potential of 72 volts was applied across the 100-kilohm resistor and the rat on the first day of shock administration. Voltage was increased systematically at intervals to a maximum of 198 volts. The current, as measured by an ac milliameter in series with the rat, ranged from .69 ma to 1.89 ma. The voltage schedule of the late-shock group was higher to offset the greater body resistance.

The dominance-test-box familiarization process was identical to that reported in Experiment 1 except that experimental *S*s were always placed at the same end of the dominance-test box; control *S*s, at the opposite end. This sped up the familiarization process and only nine days (instead of 11) were needed. On the ninth trial, almost all *S*s showed latencies of less than .03 minute to reach the food container; and no *S* took more than .06 minute.

The familiarization process permitted *E* to take two measures of individual differences in emotionality. The first measure was the ordinal number of the trial in which *S* spent a total of one minute or more at the food container (9). The second measure was the ordinal number of the trial in which *S* emerged from his cage in .05 minute or less (2). For the sake of convenience emotionality when indicated by eating time will be called *fearfulness;* when measured by cage-emergence latency, *timidity*.

Each competition set took seven days, the time necessary for a complete round of 49 intersubgroup pair comparisons at the rate of one competition per day per *S*. One *S* in the no-extra-stimulation group and three *S*s in the late-shock group died before the time of testing, which resulted in those groups having competition sets with 42 and 30 pair comparisons respectively. *S*s within the same subgroup did not compete with each other, as was the case in Experiment 1.[2] In all other respects, there was no difference in dominance testing.

*S*s were fed ad libitum from weaning through Day 38, at which time all food was removed and the same deprivation schedule reported in Experiment 1 was instituted.

2. *Results*

a. Series A. The percentage of wins for each experimental subgroup is summarized in Figure 3 (Series A), and the number of winners and losers in each set is presented in Table 2 (Series A).[3] A win was defined as a bout in which *S* spent a greater amount of time at the food container than did his opponent *and* if the difference in time was greater than .10 minute. If the difference did not exceed .10 minute, a tie was scored, in which case each *S* was given half a win. A winner was defined as any *S* having more wins than losses for any given competition set; a loser was defined as any *S* not having more wins than losses for any given set.

Of the four groups that started competitions on Day 48 (the first trial of the first-competition set of Series A [Set A1]), no significant differences were found between the respective subgroups in the frequencies of winners and losers. When the frequencies in the four groups are combined for greater reliability, the null hypothesis is maintained.

By the final-competition set in Series A (Set A9), all of the six early-stimulation groups (but not the late-shock group) showed significant differences in the frequencies of winners and losers, *but not all in the same direction.* The experimental *S*s in the extra-stimulation, no-extra-stimulation, midway-dominance-test, and no-preadolescent-dominance-test groups showed greater dominance; in the postadolescent-dominance-test and continuous-dominance-test groups, they showed greater subordination. When the frequencies of winners and losers in the final set of Series A (Set A9) in all seven groups are combined to determine allover significance, the findings are significant at the

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[2] Generally, data to be analyzed for inferences concerning population differences should be obtained from both intergroup and intragroup competitions (4); however, in the case where one group has 100 per cent of the wins, and the analysis is based on the differential frequencies of winners and losers in each group, it makes no difference.

[3] Absolute eating-time scores for each *S* for all competitions, on which these summaries are based (as well as those of Series B and C), can be found in the appendix of the original dissertation on which this report is based (4).

TABLE 2

FOURFOLD-CONTINGENCY TABLES CONTAINING NUMBER OF WINNERS (W) AND LOSERS (L) IN EXPERIMENTAL AND CONTROL SUBGROUPS AND RESPECTIVE p VALUES*

Group	Series A									Series B				Series C		
	1[a] 48[b] W L	2 55 W L	3 62 W L	4 69 W L	5 76 W L	6 83 W L	7 90 W L	8 97 W L	9 104 W L	1 111 W L	2 118 W L	3 125 W L	4 132 W L	1 139 W L	2 146 W L	3 195 W L
Extra-stimulation																
Experimental	4 3								7 0	7 0	7 0	7 0	7 0	7 0	7 0	7 0
Control	0 7								0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7
p	.07								.001	.001	.001	.001	.001	.001	.001	.001
No-extra-stimulation																
Experimental	2 5								7 0				7 0			
Control	3 3								0 6				0 6			
p									.001				.001			
Midway-dominance-test																
Experimental	5 2				7 0				7 0				7 0			
Control	3 4				0 7				0 7				0 7			
p					.001				.001				.001			
No-preadolescent-dominance-test																
Experimental									7 0				7 0			
Control									0 7				0 7			
p									.001				.001			
Post-adolescent-dominance-test																
Experimental					0 7				0 7				0 7	0 7	1 6	2 5
Control					6 1				7 0				7 0	7 0	6 1	5 1
p					.004				.001				.001	.001	.03	
Continuous-dominance-test																
Experimental	4 3	4 3	5 2	5 2	2 5	1 6	1 5	0 7	0 7				3 4	4 3	5 2	3 4
Control	3 4	3 4	2 5	2 5	5 2	6 1	6 1	6 1	7 0				5 2	2 5	3 4	5 2
p						.03	.05	.004	.001							
Late-shock																
Experimental									1 4				4 1			
Control									3 3				2 4			
p																
All groups																
Experimental	15 13								29 18				35 12			
Control	9 18								17 30				14 33			
p									.03				.001			

* Differences are significant at or beyond the individual p value, which (for the individual groups) is based on Fisher's exact test and (for the combined groups) on the chi-square test (corrected for continuity). p values not recorded represent insignificant contingencies.

[a] Each competition set, at one competition per *S* per day, lasted seven days. The set numbers refer to continuous seven-day periods beginning on Day 48, with the exception of the very last set (C3), which began after a six-weeks period of rest for all groups participating in Series C.

[b] *S*'s age (in days) on first trial of each competition set.

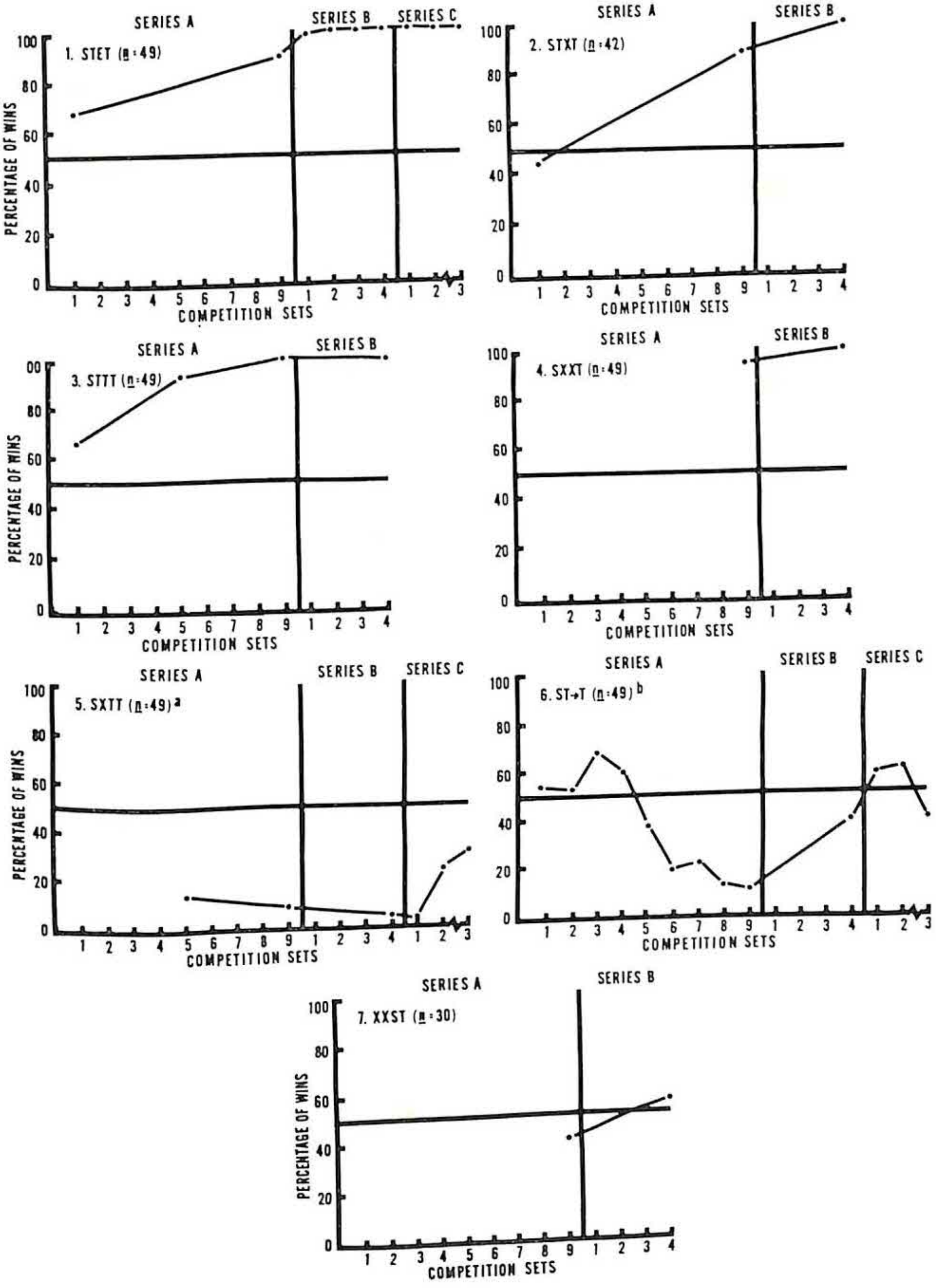

FIGURE 3

Percentage of Wins of Experimental Subgroups for Each Competition Set (*n* refers to the number of competitions in each set. [a] In Set C3, $n = 42$ because of the death of 1 *S*. [b] In Set A7, $n = 42$ because of the temporary illness of 1 *S*.)

.03 level (chi square = 5.15) in favor of the shocked *S*s. The experimental subgroups also won 62 per cent of all competitions.

Fearfulness scores and timidity scores are summarized in Table 3. In the four groups whose shocked *S*s had become dominant by Set A9 ("regular" groups), no substantial difference in fearfulness was found between the shocked and control subgroups. In the two groups whose findings are in the opposite direction ("deviant" groups) and in the late-shock group, fearfulness scores were substantially higher in the experimental *S*s. As for timidity, there was a general tendency for shocked *S*s to score lower than controls. The four groups that started competing on Day 48 (Set A1) were combined for greater reliability, and their emotionality scores were compared. These four groups represent the largest block of *S*s tested on emotionality during the same developmental stage and whose scores are comparable (5). There is little difference between the subgroups in the fearfulness scores, but the timidity scores are significantly lower in the shocked subgroups.

b. Series B. The author decided to test the *S*s further to determine under a different schedule of dominance testing the stability of the relationships found. All seven groups were given a dominance test starting on Day 132, after an interval of three weeks. In addition, the extra-stimulation group chosen at random to represent the "regular" groups, was given three continuous-competition sets during the three-week interval; and the continuous-dominance-test group already on a continuous-competition-set schedule, was permitted to rest during the interval [*see* Figure 2].

The percentage of wins for each experimental subgroup is summarized in Figure 3 (Series B), and the number of winners and losers in each set is presented in Table 2 (Series B). In terms of the number of winners and losers, the four "regular" groups remained absolutely stable. In terms of the percentage of wins, the shocked *S*s in three of the four "regular" groups reached the 100 per cent mark; in the remaining group, the 99 per cent mark, indicating a consolidation of gains. The experimental subgroup of the "deviant" postadolescent-dominance-test group also seemed to consolidate its "gains" by approaching even closer to but not quite reaching the zero per cent mark. The experimental *S*s in the remaining "deviant" continuous-dominance-test group made a partial comeback in the direction of the 50 per cent mark, reducing the proportion of winners and losers in the two subgroups to that easily found by chance. The shocked *S*s in the late-shock group gained some winners and some wins but were well within chance limits. When the frequencies of the winners and the losers in the last set of Series B (Set

TABLE 3

MEAN FEARFULNESS AND TIMIDITY SCORES (AND STANDARD DEVIATIONS) AND CORRELATIONS BETWEEN THE TWO MEASURES

Group and measure	Experimental *S*s Mean	Experimental *S*s *SD*	Control *S*s Mean	Control *S*s *SD*	Difference between means	*t*	r^a
1. Extra-stimulation ($N = 7 + 7$)							
Fearfulness	2.43	1.05	2.43	1.18	0.00	0.00	.45
Timidity	4.00	1.07	5.14	1.64	—1.14	1.43	
2. No-extra-stimulation ($N = 7 + 6$)							
Fearfulness	3.29	1.28	4.17	1.57	—0.88	1.02	.69**
Timidity	4.71	1.58	5.50	2.57	—0.79	0.62	
3. Midway-dominance-test ($N = 7 + 7$)							
Fearfulness	2.86	0.99	3.43	1.05	—0.57	0.97	.31
Timidity	3.71	1.91	5.43	1.50	—1.72	1.73	
4. No-preadolescent-dominance-test ($N = 7 + 7$)							
Fearfulness	3.86	0.99	3.57	1.40	+0.29	0.41	.59*
Timidity	7.14	2.10	6.86	2.47	+0.28	0.22	
5. Post-adolescent-dominance-test ($N = 7 + 7$)							
Fearfulness	3.71	2.55	2.00	0.76	+1.71	1.58	.85**
Timidity	6.00	2.78	4.86	1.12	+1.14	0.93	
6. Continuous-dominance-test ($N = 7 + 7$)							
Fearfulness	5.86	2.10	3.71	1.16	+2.15	2.19*	.27
Timidity	5.57	1.76	7.14	2.42	—1.57	1.29	
7. Late-shock ($N = 5 + 6$)							
Fearfulness	5.20	1.17	3.17	2.11	+2.03	1.74	.71**
Timidity	8.20	1.83	7.33	2.69	+0.87	0.55	
8. Groups 1, 2, 3, and 6 combined ($N = 28 + 27$)							
Fearfulness	3.61	1.95	3.41	1.39	+0.20	0.43	.50**
Timidity	4.50	1.76	5.81	2.21	—1.31	2.40*	

[a] Based on *S*s of experimental and control subgroups combined.

* Significant at the .05 level.

** Significant at the .01 level.

B4) in all seven groups are combined for the purpose of testing the overall reliability of the difference, the frequencies found are significantly different from chance in the direction favoring the shocked *S*s at less than the .001 level (chi-square = 17.05). In addition, the combined experimental *S*s won 71 per cent of all competitions.

c. Series C. In view of the instability of one of the "deviant" groups (the continuous-dominance-test group), the author decided to test further that group for indications of eventual stability, to test further the remaining "deviant" group (the postadolescence-dominance-test group) in the event that it follow the same pattern as the continuous-dominance-test group, and to continue testing the extra-stimulation group as representative of the "regular" groups. The continuous-dominance-test group, the postadolescence-dominance-test group, and the extra-stimulation group was given two continuous-competition sets immediately following the final set of Series B and beginning on Day 139. A rest period of six weeks was introduced for personal reasons of *E* and was followed by one final set that began on Day 195 [*see* Figure 2].

The percentage of wins for each of the three experimental subgroups is summarized in Figure 3 (Series C), and the number of winners and losers in each set is presented in Table 2 (Series C). In terms of the number of winners and losers, the extra-stimulation group continued to remain absolutely stable (although, in terms of the number of wins, some very small degree of deconsolidation seemed to appear on the final set of the series). The continuous-dominance-test group remained fairly stable and close to the 50 per cent mark. The postadolescent-dominance-test group eventually followed the same pattern of the continuous-dominance-test group and re-entered the chance-probability area where it seemed to approach stability at less than the 50 per cent mark.

3. *Discussion*

a. Partial replication. The results obtained during preadolescent testing do not replicate those found in Experiment 1. Since the preadolescent inversion, or initial subordination of the shocked *S*s, did not appear in the present experiment, the variables responsible for the resolution of the inversion in Experiment 1 could not be determined. How can the failure to replicate the inversion be explained? It is possible that some change in the apparatus or in the procedure in the present experiment produced in the experimental *S*s either (*a*) a weaker conditioned emotional response, which would be less effective in inhibiting the manifestation of the potential for superior competitive ability based on superior physiological adaptation, or (*b*) greater physiological adaptation, which would offset the inhibiting effects of a conditioned emotional response. It is also possible that the same change in the apparatus or the procedure precluded altogether the presumed learning of an inhibiting emotional response or whatever might have caused the initial inversion in Experiment 1. If this be true, the data suggest that the social superiority through physiological adaptation of the shocked *S*s becomes evident only after maturity is reached and remains latent during the preadolescent period when hormonal changes have not yet occurred (24).

On the whole, however, the results obtained during adult testing may be considered as replicating those found in Experiment 1. The results obtained in the various groups suggest that the differences found between the shocked *S*s and control *S*s in adulthood testing can occur (*a*) with or without extra hoarding and exploratory experience, (*b*) with or without competition experience in preadolescence or postadolescence, and (*c*) at least as early as the postadolescent period.

b. Emotionality and the "deviant" groups. The results obtained during the preadolescent testing of two aspects of emotionality indicate that not all aspects of emotionality are equally influenced by postweaning electrical stimulation. This is an agreement with the Hunt and Otis's findings (11) and is not surprising in view of the fact that timidity and fearfulness scores had only 25 per cent of their variances in common. From the point of view of social behavior, it is important to determine the relative weight of each aspect of emotionality that mediates (or at least covaries with) the advantage gained in the social situation where a competing organism threatens. To put the matter another way, it is important to know which of the various aspects of emotionality best indicate the efficiency of the physiological stress response to social threat presumed to mediate social status.

The exceptional results obtained in the two "deviant" groups (the post-adolescence-dominance-test group and the continuous-dominance-test group) may be accounted for on the basis of *sampling error* if it is assumed that the experimental *S*s in those groups scored substantially higher on fearfulness before shock treatment. Table 3 shows that of the six early-stimulation groups, the two "deviant" groups are the only ones whose experimental *S*s scored substantially higher on fearfulness in spite of extra stimulation. It is not surprising, then, that the less-fearful control *S*s in the "deviant" groups were able to become socially dominant in adulthood for a period of time. That they lost their advantage in later testing is more puzzling. Perhaps fearlessness indicates a temporary advantage that appears permanent only when social

5. When time limitations require a single competition set, *S*s should be tested no earlier than the postadolescent period if maximal differences are sought. Differences obtained earlier may be minimal or even reversed.

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